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# PROCEEDINGS

OF THE

# AMERICAN SOCIETY

OF

# CIVIL ENGINEERS

VOL. XLV—No. 2

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

February, 1919

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# PROCEEDINGS

OF THE

# AMERICAN SOCIETY

OF

# CIVIL ENGINEERS

(INSTITUTED 1852)

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VOL. XLV—No. 2

FEBRUARY, 1919

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Edited by the Secretary, under the direction of the Committee on Publications.

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NEW YORK 1919

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# American Society of Civil Engineers

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*Term expires January, 1921:*
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LEONARD METCALF

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*Treasurer,* ARTHUR S. TUTTLE

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*Assistant Secretary,* T. J. McMINN

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*On Special Committees:*
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LEONARD METCALF

## Special Committees

TO CODIFY PRESENT PRACTICE ON THE BEARING VALUE OF SOILS FOR FOUNDATIONS, ETC.: Robert A. Cummings, Edwin Duryea, E. G. Haines, Allen Hazen, James C. Meem, Walter J. Douglas.

ON THE REGULATION OF WATER RIGHTS: F. H. Newell, W. C. Hoad, John H. Lewis.

TO REPORT ON STRESSES IN RAILROAD TRACK: A. N. Talbot, A. S. Baldwin, G. H. Bremner, John Brunner, W. J. Burton, Charles S. Churchill, W. C. Cushing, Robert W. Hunt, George W. Kittredge, Paul M. LaBach, C. G. E. Larsson, G. J. Ray, Albert F. Reichmann, H. R. Safford, F. E. Turneaure, J. E. Willoughby.

The Reading Room of the Society is open from 9 A. M. to 10 P. M. every day, except Sundays, Fourth of July, Thanksgiving Day, and Christmas Day.

HEADQUARTERS OF THE SOCIETY—33 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE NUMBER.....4600 Vanderbilt.
CABLE ADDRESS.....“Ceas, New York.”

Vol. XLV. FEBRUARY, 1919. No. 2.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852.

# PROCEEDINGS

This Society is not responsible for any statement made or opinion expressed in its publications.

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## MINUTES OF MEETINGS OF THE SOCIETY

### SIXTY-SIXTH ANNUAL MEETING*

**January 15th, 1919.**—The meeting was called to order at 10 A. M., in the Auditorium of the Engineering Societies Building; President Arthur N. Talbot in the chair; Chas. Warren Hunt, Secretary; and present, also, about 650 members.

Vice-Presidents George S. Webster and George W. Kittredge were invited to take seats on the platform.

The President announced that he had appointed Messrs. P. P. Farley, J. W. F. Bennett, A. S. Crane, James Forgie, L. V. Morris, J. W. Nelson, C. U. Powell, E. J. Rosencrans, and B. H. Wait as Tellers to Canvass the Ballot for Officers for the ensuing year.

* A full report of the Sixty-sixth Annual Meeting is printed on pages 131 to 150 of this number of *Proceedings*.

The President delivered the Annual Address.*

The Annual Report of the Board of Direction, and the Annual Reports of the Secretary and of the Treasurer,† for the year ending December 31st, 1918, were presented and accepted.

The Secretary read the report of the Committee to Recommend the Award of Prizes,‡ and announced that the medals and prizes for the year ending July, 1918, had been awarded by the Board of Direction in conformity with that report, as follows:

The Norman Medal to Paper No. 1396, "Multiple-Arch Dams on Rush Creek, California", by L. R. Jorgensen, M. Am. Soc. C. E.

The J. James R. Croes Medal to Paper No. 1388, "Tunnel Work on Sections 8, 9, 10, and 11, Broadway-Lexington Avenue Subway, New York City", by Israel V. Werbin,§ Assoc. M. Am. Soc. C. E.

The Thomas Fitch Rowland Prize to Paper No. 1397, "The Reconstruction of the Stony River Dam", by F. W. Scheidenhelm, M. Am. Soc. C. E.

The James Laurie Prize to Paper No. 1391, "Unusual Coffer-Dam for 1 000-Foot Pier, New York City", by Charles W. Staniford, M. Am. Soc. C. E.

The Collingwood Prize for Juniors to Paper No. 1379, "Designing an Earth Dam Having a Gravel Foundation, With the Results Obtained in Tests on a Model", by James B. Hays, Jun. Am. Soc. C. E.

The Secretary presented the report of the Tellers appointed by the Board of Direction to canvass the final suggestions for members of the Nominating Committee, to represent certain districts, and the following were appointed to serve for two years:

| | | | | |
|---|---|---|---|---|
| J. J. Yates | Representing | District | No. | 1 |
| F. P. Williams | " | " | " | 3 |
| J. S. Conway | " | " | " | 5 |
| N. S. Sprague | " | " | " | 6 |
| F. E. Weymouth | " | " | " | 10 |
| W. K. Barnard | " | " | " | 11 |
| H. L. Haehl | " | " | " | 13 |

Desmond FitzGerald, Past-President, Am. Soc. C. E., Chairman of the Special Committee on Engineering Education, presented the report of Dr. Mann, of the Carnegie Foundation for the Advancement of Teaching, as the final report of that Committee. Mr. FitzGerald also offered a resolution to the effect that the President be authorized to

* See page 29 of Papers and Discussions.

† For these reports see pages 27 to 42 of *Proceedings* for January, 1919 (Vol. XLV).

‡ See page 132.

§ Mr. Werbin resigned his membership in the Society on December 31st, 1917.

appoint a committee of three to confer with committees of the other Societies in order to secure a complete discussion of Dr. Mann's report.

On motion, duly seconded, the resolution was referred to the Board of Direction, and the Special Committee on Engineering Education was discharged with thanks.

Robert A. Cummings, M. Am. Soc. C. E., Chairman of the Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, reported progress.

The Secretary presented, for the Special Committee to Report on Stresses in Railroad Track, a brief progress report.*

The Secretary presented a letter from F. H. Newell, M. Am. Soc. C. E., Chairman of the Special Committee on the Regulation of Water Rights, requesting that the Committee be continued for another year.

On motion, duly seconded, the Special Committee on the Regulation of Water Rights was continued.

The Secretary stated that he had been requested by Onward Bates, Past-President, Am. Soc. C. E., Chairman of the Committee on the Alfred Noble Memorial, to report briefly that, although the project had been held up on account of the war, it was as much alive as ever in the minds of the Committee, and that it is the intention to complete the Memorial as soon as the way is open for making progress.

The Secretary presented the Preliminary Report of the Committee on Development.†

The report was accepted and the Committee continued.

The Secretary reported that the following resolution had been adopted by the Board of Direction at its meeting on January 14th, 1919:

"The Board of Direction of the American Society of Civil Engineers, having considered the resolutions passed by the Brooklyn Engineers' Club in regard to the summary dismissal of about 350 engineering employees of the Public Service Commission, District No. 1, State of New York,

*"Resolved,* That, on the statement of facts thus presented, the dismissal of these employees, many of them specifically qualified for the difficult undertaking in which they were engaged, was not only eminently unjust and an offence to the Engineering Profession, but was directly opposed to the best interests of the City of New York, and therefore opposed to the best interests of the country;

*"Resolved,* That this Board, recognizing this to be a matter upon which the Engineering Council has properly taken prompt action, and understanding that a hearing of those directly concerned has been called for this afternoon, the record of this action be filed at once with the Secretary of the Engineering Council."

On motion, duly seconded, the action of the Board of Direction was approved by the meeting.

* See page 139.

† Printed in *Proceedings* for December, 1918, p. 1117.

The Secretary announced the election of the following candidates on January 13th, 1919:

As Members

Charles Irving Anderson, Chicago, Ill.
Edward Stewart Anderson, Pocatello, Idaho
Theodore Alexander Beyer, Salt Lake City, Utah
George Holloway Cairns, Gainesville, Fla.
Andrew Arnold Cohill, New York City
Ralph Hawes Gage, Chicago, Ill.
James Osberne Hackenberg, Wilmington, Del.
Samuel Prescott Hall, Columbus, Ohio
Arthur Albert Johnson, Washington, D. C.
Barzillai Allen Rich, Hingham, Mass.
Herbert Lafayette Russell, Detroit, Mich.
Acheson Smith, Niagara Falls, N. Y.

As Associate Members

Lamar Acker, Nacogdoches, Tex.
Andrew Elliott Anderson, Brownsville, Tex.
Leroy Arnold, Kansas City, Kans.
Wendell Philip Ball, Cincinnati, Ohio
William Earnest Beilharz, Dallas, Tex.
Thomas Joseph Boyle, Fortyfort, Pa.
Franklin Henry Chapin, Anchorage, Alaska
William Henry Collisson, Jr., Ocean City, N. J.
Oliver Raymond Dinsmore, Minneapolis, Minn.
Nathan Washington Dougherty, Knoxville, Tenn.
Everett Wesley Dunn, Sioux City, Iowa
Ernest Evers, Arroyo Grande, Cal.
Arthur E. Farrington, Camp Lee, Va.
Arthur Jenkins Ford, Los Angeles, Cal.
Robert Myron Fox, Warren, Ariz.
Ralph Welles Gaylord, Honolulu, Hawaii
Morris Goodkind, Lynbrook, N. Y.
Fred Justus Grumm, San Diego, Cal.
Gerardus Harrisson, Lima, Ohio
Norman Haden Hill, Washington, D. C.
Laurence Hussey, Boston, Mass.
Harold Dean Jolley, Omaha, Nebr.
John Frederick Jung, New York City
Edward Leo Larkin, New York City
Peter Francis La Valle, Valier, Mont.
James Blair Long, Norristown, Pa.
Richard Lipkey Longshore, Montpelier, Ohio

John Wesley Lowell, Jr., Pittsburgh, Pa.
John Lucey, Santiago, Dominican Republic
Clark Orromell Markhart, Pittsburgh, Pa.
Earle Mauldin, Winston-Salem, N. C.
Allan David Millard, Beardstown, Ill.
Walter Moore, Jr., Los Angeles, Cal.
Thomas Clinton Mullins, Boonville, Ind.
Joseph Augustine Murray, Jr., Philadelphia, Pa.
Edward Douglas Nickerson, Sacramento, Cal.
John Marshall Page, Aberdeen, Md.
Harry John Phillips, New York City
William Stanton Root, Am. Exp. Forces, France
Clarence Stanley Sale, New York City
Ole Singstad, Brooklyn, N. Y.
Hyrand Arakel Sivaslian, Akron, Ohio
Erwin Weir Smith, Houston, Tex.
Thomas Elwood Stanton, Jr., Sacramento, Cal.
Benjamin Ellis Warren Stout, Kansas City, Mo.
Daniel Voiers Terrell, Lexington, Ky.
Clarence Henry Trask, Penniman, Va.
William Henry Trinkaus, Chicago, Ill.
Samuel Newbold Van Trump, Wilmington, Del.
Martin Wallace Watson, Topeka, Kans.
Foster Pratt Wentz, Portland, Ore.
Roland Howard Willcomb, Lowerotay, Cal.
Guy Morris Williams, Washington, D. C.

As Juniors

Munson Julius Dowd, Long Beach, Cal.
Maurice David Glessner, Camp A. A. Humphreys, Va.
Vicente Mills, Manila, Philippine Islands
James Alan Noxon, Columbia, S. C.
Fernando Charles Pioda, Seattle, Wash.
John Perry Shumaker, Xenia, Ohio

The Secretary announced the transfer of the following candidates on January 13th, and 14th, 1919:

From Associate Member to Member

Frederick Wilhelm Albert, Burlington, Vt.
John Ayer, Medford, Mass.
Lucius Tullius Berthe, Charleston, Mo.
Benjamin Alexander Hodgdon, East Orange, N. J.
Alfred Raymond Lindsey, Philadelphia, Pa.
Alexander Sydney Lynch, West Haven, Conn.

Dana Quick McComb, Corregidor, Philippine Islands
Charles Louis Meyer, Omaha, Nebr.
Alexander Norman Miller, Denver, Colo.
George Emil John Pistor, New York City
Nathan Thomas Veatch, Jr., Kansas City, Mo.
John Leonard Vogel, Jersey City, N. J.
William Wilson, Tokyo, Japan
Frank Coy Woodward, Camp A. A. Humphreys, Va.
Norman Cooper Woody, St. Louis, Mo.

From Associate to Associate Member

Alexander Allen MacVicar Russell, Berkeley, Cal.

From Junior to Associate Member

Ray William Berdeau, Camp Sevier, S. C.
Walter Augustus Buell, Cuyahoga Falls, Ohio
Edward Louis Haberle, Minneapolis, Minn.
Edward Crittenden Harding, Jr., Dayton, Ohio
Frank Helm, Topeka, Kans.
Frank Miles Kuchar, Muscle Shoals, Ala.
Karl Andrew Miller, Am. Exp. Forces, France
Martin J. Orbeck, Am. Exp. Forces, France
James Rex Pemberton, Flint, Mich.
Emile Leonard Rimbault, New York City
Max Steinberg, Washington, D. C.
Andrew Jackson Van Sise, Audubon, Iowa
Robert Yule Walker, Oklahoma, Okla.
Alphonse Mueller Westenhoff, Cincinnati, Ohio
Sydney Wilmot, New York City

The Secretary announced the following deaths:

William Appleton Haven, of Buffalo, N. Y., elected Member, March 5th, 1873; died January 6th, 1919.

George Alexander Just, of Long Island City, N. Y., elected Junior, September 3d, 1884; Member, March 4th, 1891; died December 27th, 1918.

Henry Prentice Morrison, of West New Brighton, N. Y., elected Member, April 6th, 1898; died December 17th, 1918.

Robert Edward Dakin, of Stevenson, Conn., elected Junior, December 2d, 1914; Associate Member, January 15th, 1917; died December 15th, 1918.

Clarence Frederick Eberly, of Perrysburg, Ohio, elected Associate Member, September 6th, 1910; died December 19th, 1918.

Charles Henry Howard Gillean, of Natchez, Miss., elected Associate Member, October 8th, 1918; died November 8th, 1918.

JOHN WILLIAM HORTON, of Sacramento, Cal., elected Junior, September 1st, 1908; Associate Member, December 2d, 1914; died December 24th, 1918.

GRANDVILLE REYNARD JONES, Capt., San. C., U. S. A., of Baltimore, Md., elected Junior, January 7th, 1908; Associate Member, May 2d, 1911; died in service (Camp Benning, Ga.), December 22d, 1918.

AUSTIN RUSSELL WILLARD SPERRY, of Anderson, Cal., elected Junior, December 6th, 1910; Associate Member, January 15th, 1917; died December 6th, 1918.

The Secretary presented invitations to the membership from T. Kennard Thomson and Francis L. Pruyn, Members, Am. Soc. C. E., to visit and inspect the foundations of the New Assay Building on Wall Street; and from Mr. D. H. Cox and R. J. Wig, Assoc. M. Am. Soc. C. E., to visit the yard of the Fougner Shipbuilding Company and inspect a concrete ship under construction.

The following resolutions were offered by R. S. Buck, M. Am. Soc. C. E.:

*"Whereas,* It is vital to the peace and welfare of our country that, during the necessary reconstruction period following the war, the number of unemployed be reduced as much as possible; and

*"Whereas,* The development of transportation, sanitation, power, and public utilities generally is necessary to the development and prosperity of the country; and

*"Whereas,* The curtailment of needed public works during the period of the war has retarded the development of the country; and

*"Whereas,* The speediest and most effective means to prevent the suffering, distress, and demoralization resulting from unemployment is afforded by public works; and

*"Whereas,* The public welfare and confidence, upon which industry generally depends, require that the construction of public works be vigorously prosecuted; therefore, be it

*"Resolved,* That the American Society of Civil Engineers, assembled in their Sixty-sixth Annual Meeting, this fifteenth day of January, 1919, desires to record its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons, but for humanitarian reasons, to furnish employment for all who can properly claim employment, especially returning soldiers; and be it further

*"Resolved,* That copies of this resolution be forwarded to such Federal, State and municipal authorities as may be able, in the opinion of the Executive Committee of the Board of Direction of the Society, to promote the purposes of these resolutions."

The resolutions were adopted unanimously.

M. O. Leighton, M. Am. Soc. C. E., Chairman of the National Service Committee, discussed the work of that committee, and asked the membership for suggestions as to the scope of its work.

Charles Hansel, M. Am. Soc. C. E., offered a resolution to the effect that the members of the four Founder Societies be asked for a subscription of $5 each to form a fund to be placed at the disposal of Engineering Council.

On motion, duly seconded, the resolution was laid on the table.

The Secretary presented the report of the Tellers appointed to canvass the Ballot for Officers for the ensuing year.

The President announced the election of the following officers:

*President, to serve one year:*

FAYETTE S. CURTIS, Boston, Mass.

*Vice-Presidents, to serve two years:*

HERBERT S. CROCKER, Denver, Colo.
LEONARD METCALF, Boston, Mass.

*Treasurer, to serve one year:*

ARTHUR S. TUTTLE, New York City

*Directors, to serve three years:*

GEORGE H. CLARK, New York City
JACOB S. LANGTHORN, New York City
CHARLES C. ELWELL, New Haven, Conn.
WILLARD BEAHAN, Cleveland, Ohio
JOHN W. ALVORD, Chicago, Ill.
C. E. GRUNSKY, San Francisco, Cal.

F. P. Stearns and Clemens Herschel, Past-Presidents, Am. Soc. C. E., conducted Mr. Curtis to the chair.

Mr. Curtis addressed the meeting briefly.

Adjourned.

**February 5th, 1919.**—The meeting was called to order at 8.30 P. M.; President Fayette S. Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, 195 members and guests.

The minutes of the meeting of December 18th, 1918, were approved as printed in *Proceedings* for January, 1919.

Francis Lee Stuart, M. Am. Soc. C. E., late Chairman, Budget Committee, Eastern Railroads, addressed the meeting on the subject, "The National Railroad Situation of To-Day and a Suggested Basis for Legislation". The subject was discussed by Messrs. T. Kennard Thomson, A. J. County, G. W. Kittredge, Calvin Tomkins, Augustus Smith, J. H. Bernhard, George J. Ray, H. C. Keith, and Francis Lee Stuart.

The Secretary announced the following deaths:

FREDERICK BROOKS, of Boston, Mass., elected Junior, June 7th, 1876; Member, January 2d, 1884; died January 10th, 1919.

Rolla Clinton Carpenter, of Ithaca, N. Y., elected Member, April 4th, 1911; died January 19th, 1919.

Marvin Watson Kingsley, of Ripley, N. Y., elected Member, July 3d, 1878; date of death unknown.

Fred Caswell Stanton, of Jacksonville, Fla., elected Associate Member, April 1st, 1908; Member, December 31st, 1913; died January 24th, 1919.

Henry Morton Stone, of St. Joseph, Mo., elected Member, April 3d, 1907; died December 8th, 1918.

Bernt Berger, of New York City, elected Associate Member, April 5th, 1893; died January 15th, 1919.

Gustavo Adolfo Dubois, of Havana, Cuba, elected Junior, September 1st, 1908; Associate Member, May 6th, 1914; died August 30th, 1918.

William Wetmore Gibbs, of Gainesville, Fla., elected Junior, October 7th, 1914; Associate Member, May 15th, 1917; died January 13th, 1919.

Victor Hugo Bell, of Coronado, Cal., elected Junior, March 14th, 1916; died in service, January 6th, 1919.

Ralph Richardson Marrian, 2d Lieut., Engrs., U. S. A., of Greenville, S. C., elected Junior, April 18th, 1916; killed in action (France), October 17th, 1918.

Charles Gilbert Reilly, Capt., Engrs., U. S. A., of Pittsburgh, Pa., elected Junior, May 7th, 1913; killed in action (France), October 1st, 1918.

Adjourned.

## OF THE BOARD OF DIRECTION

(Abstract)

**January 13th, 1919.**—The Board met at 10.15 A. M.; President Talbot in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Alvord, Coleman, Darling, Fay, Flinn, Fort, Hawgood, Ketchum, Khuen, Kittredge, Marx, Noble, Pegram, Rights, Wagner, Wall, and Webster.

Mr. Kittredge, Chairman of the Finance Committee, presented a statement of the present condition of the finances of the Society, together with a proposed Budget for 1919, which Budget was recommended to the incoming Board for adoption.

Mr. Flinn, Chairman of the Library Committee, reported the following resolutions adopted January 9th, 1919, by the Library Board of the United Engineering Society:

"*Resolved:* That the Library Board hereby recommends to the Board of Trustees that the Engineering Societies Library be recata-

logued as one library as soon as possible, under the direction of the Director, it being understood that the cost will be from $20 000 to $25 000.

"*Resolved:* That the four Founder Societies be requested to make additional appropriations of $2 500 per year per society to meet the above expenses."

The Board adopted the following resolution:

"*Resolved:* That the American Society of Civil Engineers approves the project for recataloguing the Engineering Societies Library and expresses its willingness to assist financially; nevertheless, this Society recommends that the cost of recataloguing be defrayed from funds of the United Engineering Society."

Mr. Rights, Chairman of the Publication Committee, reported a recommendation that, in order to reduce the cost of the Year Book for 1919, the alphabetical list and the list of deceased members be omitted.

On motion, duly seconded, it was decided to retain all the lists in the Year Book for 1919.

The Report of the Board of Direction prepared by the Executive Committee was presented, amended, and adopted for presentation to the Annual Meeting.*

The minutes of the meetings of the Executive Committee of November 1st and November 22d, 1918, and the actions taken at these meetings concerning the financial condition of the Society; Invitation from the French Society of Engineers to send a Delegation to attend a Conference in Paris on Reconstruction;† Exemption from Dues on Account of Military Service; Report of Committee on Reconstruction; Establishment of National Service Committee in Washington;‡ etc., were approved.

The Secretary reported that several verbal reports of progress, but no final report, had been received from the Committee on Setting and Judging Engineering Problems. The whole matter was referred to the Committee on Special Committees.

A committee consisting of Messrs. J. L. Van Ornum, Chairman, Mortimer E. Cooley, William Cain, Chas. D. Marx, and Geo. F. Swain, has been considering the question of Student Branches for some time, and a report, dated November 14th, 1918, signed by every member of the Committee except Mr. Cooley was presented; a report signed by Mr. Cooley, dated January 9th, 1919, was also presented.

On motion, duly seconded, it was voted that this Board favors the establishment of Student Branches, and refers the whole matter to the Committee on Development.

* *Proceedings*, Am. Soc. C. E., January, 1919, pp. 27-38.

† *Proceedings*, Am. Soc. C. E., December, 1918, p. 1107.

‡ *Proceedings*, Am. Soc. C. E., December, 1918, p. 1106.

Mr. Alvord, Chairman of the Committee on Special Committees, reported progress.

Messrs. Arthur N. Talbot and Joseph R. Worcester were appointed to represent this Society on Engineering Council, to succeed Messrs. F. H. Newell and George F. Swain.

The following resolutions prepared by Cadwalader, Wickersham and Taft, attorneys for The Bowery Savings Bank, forwarded through Parker and Aaron, counsel for the Society, were presented and unanimously adopted:

"*Resolved:* That the time for the payment of a certain bond and mortgage for the sum of Two hundred thousand dollars ($200 000), which is about to be assigned to The Bowery Savings Bank, covering premises known by the street numbers 218 and 222 West 57th Street, in the Borough of Manhattan and City of New York, the said mortgage being recorded in the office of the Register of the County of New York, on December 15, 1916 in section 4, Liber 267 of Mortgages, page 329, which said mortgage now bears interest at the rate of five per centum per annum, be extended for the term of five years, with interest thereon at the increased rate of six per centum per annum, payable half-yearly on the first days of February and August during said extended term, with the privilege, after the expiration of one year, of making payments on account of said principal sum of Two hundred thousand dollars ($200 000) in multiples of Ten thousand dollars ($10 000) at any time, and that an agreement to that effect be entered into between this corporation and the said Bank under the corporate seal of this corporation, and that the President or a Vice-President, and the Secretary of this corporation be and they hereby are authorized and directed to affix the corporate seal of this corporation to said agreement and to execute, acknowledge, and deliver said agreement containing such covenants, provisions and clauses as may be required by the said Bank or its counsel to be inserted therein."

The Secretary reported that the old Society House had been changed into a fine commercial building, and that the Ajax Rubber Company had been in possession since December 15th, 1918.

The Secretary reported the appointment, by the Executive Committee, of delegates to the Joint Engineering Congress in Paris.

The Secretary presented the resolutions adopted by the Duluth Association of Members, endorsing the action of the Executive Committee in sending a delegation of engineers to France, but protesting that the delegation, composed of five engineers from New York City and one from Boston, is not geographically representative of the Society. The Secretary was instructed to draft a letter* stating in detail the reasons for the action taken, and to forward a copy to each of the Local Associations.

The Secretary presented the resolutions adopted by the Duluth Association urging that the Board should specially authorize a meeting

* See page 198.

of the Development Committee at the time of the Annual Meeting; also by the San Francisco Association; also Minutes of Meetings of the Texas, St. Louis, Pittsburgh, Nebraska, and Seattle Associations showing their views regarding the Committee on Development. The Secretary was instructed to reply,* expressing the views of the Board of Direction, and sending a copy of Secretary Howson's letter to those Associations.

The Secretary presented a letter from Mr. J. A. Ockerson, stating his opinion that Mr. John W. Alvord is not eligible for election at this time as a Director of the Society, under the provisions of Art. V, Sec. 4, of the Constitution. Action had already been taken by the Board at a previous meeting, but, after thorough discussion, the following resolution was placed on record:

*"Resolved:* That the Board of Direction rules that the appointment of a member of the Board to fill the unexpired term of a member of the Board of Direction, does not constitute an election of said member, and, therefore, does not make such member ineligible to election."

The Secretary presented a communication from the Secretary of Engineering Council transmitting a vote asking that the unexpended balance of the appropriation made to Engineering Council for 1918 be re-appropriated for the uses of Engineering Council, it being intended to apply it to the work of the National Service Committee in Washington. The request, so far as this Society is concerned, was granted.

The Secretary presented several letters in reference to the American Engineering Standards Committee, among them one from J. Martin Schreiber, of that Committee, stating four important actions taken by the Committee, briefly, as follows:

1. Approval of budget for year 1919, which carries with it the appropriation of $1 200 from each Founder Society.

2. Appropriation to cover expenses for the remainder of the year 1918.

3. Complete lists with addresses of members of committees of Founder Societies engaged in standardization work.

4. Order of appointment of Founder Society representatives and tenure of office.

The Secretary presented a history of the matter, in so far as it relates to the representation of this Society on the Committee.

The resignation of Mr. John H. Gregory as a member of the Committee was presented and accepted.

The Secretary was instructed to say to the Chairman of the Committee that the $500 which the Board had appropriated was to cover

* See page 200.

its share of the expense for one year from the date of the appropriation (October 8th, 1918), and that any further appropriation for 1919, if made, must be acted on by the incoming Board of Direction.

A committee was appointed to consider and report later to the Board on the matter of representatives of this Society on the American Engineering Standards Committee. This Committee subsequently reported the nomination of Mr. Henry Jackson Burt, and recommended that the term of Mr. Schreiber be for one year, of Mr. Latey for two years, and of Mr. Burt for three years. The recommendation of the Committee was adopted.

A report was received from the Committee to Recommend the Award of Prizes. It was voted that the recommendations of the Committee be approved and that the medals and prizes be awarded by the Board in accordance therewith.*

The Secretary reported that Mr. J. V. Davies had accepted his re-election as one of the representatives of this Society in the United Engineering Society for a term of three years.

The Secretary presented a letter from Mr. Fraser S. Keith, Secretary of the Engineering Institute of Canada, addressed to the Council of the American Society of Civil Engineers, extending cordial greeting of felicitation and good will. The Secretary was instructed to reply.

The Secretary reported that, on invitation from the Society for the Promotion of Engineering Education, President Talbot had appointed George F. Swain, Past-President, Am. Soc. C. E., to represent the Society at a special meeting, held December 6th and 7th, 1918, in connection with the British Educational Mission at the Massachusetts Institute of Technology.

Charles D. Marx, Past-President, Am. Soc. C. E., was appointed as a representative of this Society on the Washington Commission of Award to succeed Mr. William H. Finley.

The Secretary presented an invitation to the Society, from the American Institute of Mining Engineers, to be represented at their next meeting in New York City, February 17th-20th, 1919. The matter was referred to the President with power, and he subsequently appointed Messrs. G. Aertsen, Albert Ladd Colby, and T. R. Lawson.

The Secretary reported that, on December 2d, 1918, at a conference of representatives of the four National Societies, and of the Society for the Promotion of Engineering Education, and the Society of Automotive Engineers, it was agreed that the Committee should be enlarged by the addition of delegates appointed by other national societies interested. Dr. Hunt was appointed to represent this Society, but, as he had been appointed to represent the Society for the Promotion of Engineering Education, he presented his resignation as a representative of this Society in order that some one else might be appointed. The Presi-

* See p. 132.

dent was authorized to appoint a member of this Society to represent it on a Committee on Technical Symbols. The Secretary also reported that at this conference it was suggested that each of the four Founder Societies be asked to appropriate $50 for the work of this Committee. The request was granted so far as this Society is concerned.

A report of the Committee to Canvass the Final Suggestions in the matter of the Nominating Committee, Messrs. Fort, Noble, and Flinn, was received and ordered presented to the Annual Meeting.*

The Secretary reported that in reply to the circular issued on November 20th, 1918, offering copies of reprints of the papers of the International Engineering Congress, 1904, free of charge, 1 104 requests for papers had been received, and up to the present time 717 of these had been filled, and that about 8 600 papers had been forwarded; that 387 requests still remain to be filled, and that probably the stock would not last.

Action was taken in regard to members in arrears for dues.

The resignations of 7 Members, 14 Associate Members, 2 Associates, and 2 Juniors, were accepted.

Ballots for membership were canvassed, resulting in the election of 12 Members, 53 Associate Members, 6 Juniors, and the transfer of 15 Associate Members to the grade of Member, 1 Associate to the grade of Associate Member, and 15 Juniors to the grade of Associate Member.

Applications were considered and other routine business transacted.

Adjourned.

**January 14th, 1919.**—The Board re-convened at 9.45 A. M.; President Talbot in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Alvord, Coleman, Darling, Davis, Fay, Flinn, Hawgood, Humphreys, Ketchum, Khuen, Kittredge, Marx, Pegram, Rights, Wagner, Wall, and Webster.

The Secretary presented a communication from the Brooklyn Engineers Club relating to the summary dismissal of more than 300 engineers by the Public Service Commission of this District and the following resolution was adopted:

"*Resolved:* That on the statement of facts thus presented, that the dismissal of these employees, many of them specifically qualified for the difficult undertaking in which they were engaged, was not only eminently unjust and an offence to the Engineering Profession, but was directly opposed to the best interests of the City of New York, and therefore opposed to the best interests of the country.

"*Resolved:* That this Board, recognizing this to be a matter upon which Engineering Council has properly taken prompt action, and understanding that a hearing of those directly concerned has been called for this afternoon, the record of this action be filed at once with the Secretary of Engineering Council."

* See p. 133.

The Secretary was instructed to report this action to the Annual Meeting.

A report from the Membership Committee was received and acted upon.

Adjourned.

**January 15th, 1919.**—The Board met at 1.35 P. M., at the Headquarters of the Society, 33 West 39th Street, New York City, at the time of the Annual Meeting, as required by the Constitution (Art. VI, Sec. 7); President Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Alvord, Beahan, Clark, Coleman, Crocker, Darling, Davis, Elwell, Flinn, Fort, Grunsky, Hawgood, Herschel, Ketchum, Langthorn, Marx, Metcalf, Pegram, Rights, Talbot, Tuttle, Wagner, and Wall.

The President announced that the next business was the election of a Secretary.

Mr. Hunt retired.

Chas. Warren Hunt was nominated and elected Secretary.

Mr. Hunt was recalled and informed of his election.

A Budget for the year 1919 prepared by the Board of Direction last year, and which was recommended to the incoming Board for adoption, was presented and adopted.

The following Standing Committees of the Board were appointed:

*On Finance:*

Nelson P. Lewis, *Chairman*
H. S. Crocker
George H. Clark
John F. Coleman
Milo S. Ketchum

*On Library:*

Alfred D. Flinn, *Chairman*
John A. O'Connor
Arthur P. Davis
Willard Beahan
Chas. Warren Hunt

*On Publications:*

Lewis D. Rights, *Chairman*
Andrew M. Hunt
Charles C. Elwell
Samuel T. Wagner
J. S. Langthorn

*On Special Committees:*

John W. Alvord, *Chairman*
Arthur S. Tuttle
Leonard Metcalf

It was voted that the next Convention be held in the "Twin Cities" of St. Paul and Minneapolis, Minn., and the President was authorized to appoint a Committee of three of the Board with power to arrange for the Convention, and he subsequently appointed Messrs. Darling, Wall, and C. W. Hunt.

The request of the New York Meetings Committee that, now that the War is over, refreshments be served at Society Meetings was granted, and appropriation for that purpose made.

The Secretary made a statement with regard to the work of the office, and suggested a method by which he could be relieved of some of the detail work, which has increased largely.

After a thorough discussion of the matter it was voted:

"*Resolved:* That the President be authorized to appoint a Committee of five, of which he shall be one, to consider the question of retiring the present Assistant Secretary and the appointment of a new Assistant Secretary, the recommendation of the Committee to be reported to the Board for action."

The President subsequently appointed to act with him on this Committee Messrs. L. D. Rights, Chairman, Geo. H. Pegram, H. S. Crocker and Samuel T. Wagner.

Adjourned.

## REPORT IN FULL OF THE SIXTY-SIXTH ANNUAL MEETING, JANUARY 15TH AND 16TH, 1919.

**Wednesday, January 15th, 1919 (10 A. M.).**—The Sixty-sixth Annual Meeting was called to order in the Auditorium of the Engineering Societies Building, 39 West 39th Street, New York City; President A. N. Talbot in the chair; on the platform, Vice-Presidents G. S. Webster and G. W. Kittredge; Charles Warren Hunt, Secretary; and present, also, about 680 Members.

THE PRESIDENT.—The Annual Meeting is now convened. I wish to announce that I have appointed the following as Tellers to Canvass the Ballot for Officers: P. P. Farley, J. W. F. Bennett, A. S. Crane, James Forgie, L. V. Morris, C. U. Powell, J. W. Nelson, E. J. Rosencrans, and B. H. Wait, and their report will be ready for presentation before the close of the meeting.

The first order of business is the Annual Address of the President.

(The President delivered the Annual Address.*)

THE PRESIDENT.—The next order of business is the report of the Board of Direction, which will be presented by the Secretary.

THE SECRETARY.—Mr. President, as you have covered a great many of these items in your Address, perhaps I may be permitted to skip a little, to save time.

(The Secretary presented the Report of the Board of Direction.†)

THE PRESIDENT.—What action will you take on the report of the Board of Direction?

A MEMBER.—I move that it be received.

THE PRESIDENT.—Is there a seconder to this motion that this report be received?

(Motion duly seconded.)

THE PRESIDENT.—Is there any discussion on the motion, or any question about the report? Those favoring the adoption of this motion will say "aye"; contrary, "no". The motion is carried.

The report of the Secretary.

THE SECRETARY.—Mr. President, this is a report of the general receipts and disbursements, and I do not think there is any real reason for reading it. The balance sheet, which will be found on Page 13‡ of the printed report, is to have an addition to it. It will be noted that in the Assets there is an estimated value of the lots owned by the Society, and the cost of the Building, less 2% annually for depreciation; also an item showing the equity of the Society in this Building at nearly $500 000.

The Board has ordered that to this be added, in a foot-note, the total cost of the lots and building on the 57th Street property, which is

* See p. 29 of Papers and Discussions.

† See *Proceedings*, Am. Soc. C. E., Vol. XLV, p. 27 (January, 1919).

‡ See *Proceedings*, Am. Soc. C. E., Vol. XLV, p. 39 (January, 1919).

$413 194.66, and the total amount paid to the United Engineering Society on account of the United Engineering Building, $262 500, which means that the Society has actually spent about $675 000 for the property which it owns and in which it has an equity. Otherwise, the opinion might still prevail, if you look at this balance sheet and see that we have nearly a million dollars to the good, that the Society had plenty of ready cash.

THE PRESIDENT.—The Treasurer's report.

(The Secretary read the Treasurer's Report.*)

THE PRESIDENT.—The reports of the Secretary and Treasurer are before you. Are there any questions?

CHARLES HANSEL, M. AM. SOC. C. E.—Mr. President, if it is in order, I feel, and I think we should all feel, that it would be a duty to help out the financial situation; and, in order to do that, permit me to suggest to the United Engineering Society a recommendation of our Society that we assess all members $5 apiece. I do not know how I should offer that resolution, or if I should offer it. I offer it at this time only as a suggestion, as the members of this Society can easily enough pay $5 or $10 apiece, in order to give the Board of Direction a sum that will put us in a dignified and easy position.

If this is not the time to offer that suggestion, I hope an opportunity to do so will be afforded during the Business Meeting.

THE PRESIDENT.—What will you do with the reports?

(It was moved and seconded that the reports be received.)

THE PRESIDENT.—It is moved and seconded that the reports be received. If there is no discussion, those favoring the adoption of this motion will say "aye"; contrary, "no". The motion is carried.

The Secretary will present the report of the Committee to Recommend the Award of Prizes, and the action of the Board of Direction in relation thereto.

THE SECRETARY.—The Board of Direction appointed Messrs. W. C. Hoad, Peter Mogensen, and H. R. Safford a Committee to Recommend the Award of Prizes. Upon the recommendation of this Committee, the Board has awarded the medals and prizes for the year ending July, 1918, as follows:

THE NORMAN MEDAL to Paper No. 1396, "Multiple-Arch Dams on Rush Creek, California", by L. R. Jorgensen, M. Am. Soc. C. E.

THE J. JAMES R. CROES MEDAL to Paper No. 1388, "Tunnel Work on Sections 8, 9, 10, and 11, Broadway-Lexington Avenue Subway, New York City", by Israel V. Werbin,† Assoc. M. Am. Soc. C. E.

THE THOMAS FITCH ROWLAND PRIZE to Paper No. 1397, "The Reconstruction of the Stony River Dam", by F. W. Scheidenhelm, M. Am. Soc. C. E.

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* See *Proceedings*, Am. Soc. C. E., Vol. XLV, p. 42 (January, 1919).

† Mr. Werbin resigned his membership in the Society on December 31st, 1917.

THE JAMES LAURIE PRIZE to Paper No. 1391, "Unusual Coffer-Dam for 1 000-Foot Pier, New York City", by Charles W. Staniford, M. Am. Soc. C. E.

THE COLLINGWOOD PRIZE FOR JUNIORS to Paper No. 1379, "Designing an Earth Dam Having a Gravel Foundation, With the Results Obtained in Tests on a Model", by James B. Hays, Jun., Am. Soc. C. E.

THE PRESIDENT.—The next order of business is the appointment of the Nominating Committee. The Secretary will present the report of the tellers on the ballots for suggestions for members of that committee.

The Secretary presented the report of the Tellers, as follows:

"TO THE BOARD OF DIRECTION:

"The undersigned tellers report the result of canvass of final suggestions for Members of the Nominating Committee in the several districts as follows:

| | | |
|---|---|---|
| *"District No. 1.*—Joseph J. Yates | | 153 |
| | John W. Hamilton | 69 |
| | Charles Hansel | 15* |
| | Scattering | 9 |
| | Total | 246 |
| *"District No. 3.*—Friend P. Williams | | 38 |
| | R. V. Rose | 24 |
| | E. A. Fisher | 15 |
| | Scattering | 4 |
| | Total | 81 |
| *"District No. 5.*—J. S. Conway | | 57 |
| | R. M. Clayton | 12 |
| | John C. Hoyt | 11 |
| | Scattering | 8 |
| | Total | 88 |
| *"District No. 6.*—N. S. Sprague | | 49 |
| | Paul Didier | 18 |
| | Morris Knowles | 11 |
| | Scattering | 15 |
| | Total | 93 |
| *"District No. 10.*—F. E. Weymouth | | 38 |
| | F. T. Darrow | 21 |
| | Robert Follansbee | 14 |
| | Scattering | 3 |
| | Total | 76 |

* A communication has been received from Mr. Hansel asking that his name be withdrawn.

| | | |
|---|---|---|
| "*District No. 11.*—W. K. Barnard | | 22 |
| | J. C. Nagle | 18 |
| | Fred A. Jones | 15 |
| | Scattering | 12 |
| | Total | 67 |
| "*District No. 13.*—H. L. Haehl | | 37 |
| | P. E. Harroun | 23 |
| | M. M. O'Shaughnessy | 10 |
| | Scattering | 2 |
| | Total | 72 |

"Respectfully submitted,

"FREDERICK C. NOBLE,
"ALFRED D. FLINN,
*"Tellers."*

The Districts were taken up separately, and, by vote of the meeting, the following members of the Nominating Committee were appointed to serve for two years:

| | | | | |
|---|---|---|---|---|
| JOSEPH J. YATES | *Representing* | *District* | *No.* | *1* |
| FRIEND P. WILLIAMS | " | " | " | *3* |
| J. S. CONWAY | " | " | " | *5* |
| N. S. SPRAGUE | " | " | " | *6* |
| F. E. WEYMOUTH | " | " | " | *10* |
| W. K. BARNARD | " | " | " | *11* |
| H. L. HAEHL | " | " | " | *13* |

THE PRESIDENT.—We come now to the reports of Special Committees. The first is the report of the Special Committee on Engineering Education, Desmond FitzGerald, Chairman.

DESMOND FITZGERALD, PAST-PRESIDENT, AM. SOC. C. E.—Mr. President and Fellow-Members: The Special Committee on Engineering Education, after about a dozen years of long and, I believe, faithful work, desires to present its Final Report; and, representing that Committee, I wish to thank the Society for its patient forbearance in allowing the Committee to continue this work without interruption. There are some engineering problems that have to be rushed through. There are others that you cannot rush. If you rush them you meet with failure; and this important matter of education is, I think, fairly to be ranked with the latter class.

When the Committee first took the matter in hand, it had to provide funds, and soon found that it was getting into water beyond its depth. The President, in his very excellent and able address this morning, has referred to the work of Special Committees as being an important part of the work of this Society, and I, for one, must say that I felt a

good deal of encouragement from those words, because, when the work is extended over so many years, one begins to feel that perhaps it has not been advanced as rapidly as it should have been; however, the Committee believes that this Final Report which it is now presenting, in the form of a report of the Carnegie Foundation, will prove of great value to those engaged in Engineering Education.

The early Committee had among its members Benjamin M. Harrod, Past-President, Am. Soc. C. E., and I do not think it ever had a more diligent worker or a more faithful and more interested member; and the members of the Committee felt his death very greatly. I felt it, especially, because I was in constant communication with him, and he never failed to give all his strength and intelligence to this difficult question.

Finally, after several years of investigation, the Committee concluded that it would require a very large sum of money and a very excellent organization, more important than it was felt the Society could provide for this subject; and, therefore, it was arranged to invite several other societies to join with this Society in a larger organization for the study of engineering education.

Now, that larger Committee has been working on this matter carefully for a good many years, and the Carnegie Foundation, after hearing all our representations on this matter, came to the conclusion that it would devote a large sum of money to this cause, and also help in any way possible. Finally, Dr. Mann was selected to head the investigation.

Now, a great many interesting things in connection with education have been brought out by this particular study. I shall not refer to many of them, but I would like to say a few words on one or two. Of course, the Rensselaer Polytechnic Institute was one of the first—and probably the first—established in this country. It was established to meet the calls of industrial manufacturers, and, in fact, the Institute of Technology, which followed later, was founded for the purpose of adding to the efficiency of the industries in this country. Later, the instruction took on more scientific forms of engineering and technology.

The Civil War changed a great many things in this country, and had a vast influence on education. Immediately after the Civil War it was very remarkable how our teaching changed, and the institutions themselves went through very noteworthy changes. Now, we, too, have just passed through a very great war, in many features of which our hearts have been wrung; but it is very doubtful if this war will produce the same changes in teaching as the Civil War, because our country has grown, developed, and we have only to look at our own Society and see what a remarkable showing it makes to-day, compared with its early days, to realize that the strength and power of the country are not to be affected in the same way that they were after 1865.

Dr. Mann's report is extremely interesting, and it is very well arranged. One of its great charms is its condensation. When it was

originally presented it contained an enormous mass of information, which he diligently condensed into its present form, and I think it is in a form which all can read with pleasure, and get results from that reading in a very short time.

This report is divided into three portions, the first of which deals with the present condition of education among the schools. Twenty typical schools were visited by Dr. Mann and very carefully studied.

The second part of the report deals with the engineering problems connected with technical education, and the third part offers some practical solutions in aid of those problems. One of the interesting results is that, when you consider the relation of engineering education to the industrial production of the country, out of 98 important manufacturing industries, 43% of the technical assistants in those industries possess engineering degrees.

Another interesting thing, to which I wish to call attention, is the fact that, of all the boys who enter the schools, 60% fail to be graduated. Some of the reasons for this are discussed in the report, and suggestions are offered.

Now, it seems to the Committee, Mr. President, that it is desirable that this report should be very carefully studied by the professors and teachers of engineering in this country; and I, as representing that Committee, would like to move that a committee of three be appointed by the President to confer with the other engineering organizations, in order to secure the careful study of this report.

THE PRESIDENT.—The Chairman of the Special Committee on Engineering Education presents the Final Report of the Committee, and moves that a committee be appointed to make a study of the report prepared by Dr. Mann.

(Motion duly seconded.)

MR. FITZGERALD.—The idea is this, and I would like to make the suggestion, that this Committee, consisting of men of eminence in the profession, should confer with other kindred societies, to bring about a careful study of this report among the teaching institutions in this country.

THE PRESIDENT.—There is also included in this motion that this Committee shall make an attempt to confer with committees of other societies and to develop a general discussion of the report throughout the country.

L. D. RIGHTS, M. AM. SOC. C. E.—Mr. President, I would like to suggest that possibly this matter might be simplified by dividing the motion. I would like to offer an amendment to that effect. First, that the report be accepted, and that the committee be discharged with thanks.

THE PRESIDENT.—That is separate from this motion, I take it.

Mr. Rights.—I understand that the Committee has presented its Final Report. I would offer it as an amendment.

(Motion duly seconded.)

The President.—The motion is made that this be amended by accepting the Final Report of the Committee; it must be added to the other motion; is that right?

Mr. Rights.—That the Committee be discharged with thanks.

The President.—And that the Committee be discharged with the thanks of the Society. Is there any discussion? Those favoring this amendment will say "aye"; contrary, "no". The motion is carried. Is there any discussion of the motion as amended? This brings about the appointment of the Committee by the Annual Meeting, which I think is not usual.

Mr. FitzGerald.—I think perhaps my motion was misunderstood—I moved that the President be authorized and requested to appoint this Committee. That does not mean that it was necessarily to be done at this Meeting.

The President.—What standing, may I ask, will the Committee have: The standing of appointment by the Annual Meeting or by the Society? May I not suggest, if this is to be done, it may be well to have it referred to the Board of Direction in order that it may be appointed in the same way that other committees have been appointed.

H. P. Eddy, M. Am. Soc. C. E.—I move to amend the motion by reference to the Board of Direction.

(Motion duly seconded.)

The President.—The whole subject, including the acceptance of the report, may we not consider then informally; that this refers to the appointment of the committee and that the motion will be divided, taking up the appointment of the committee later?

Those favoring the reference of the report of the Committee to the Board of Direction, say "aye"; contrary, "no". The motion is carried.

Those favoring the motion that the report of the Committee be accepted and that the committee be discharged with the thanks of the Society will say "aye"; contrary, "no". The motion is carried.

The Secretary.—May I interrupt the regular order of business for one moment? There are so many people in the room that this would be a good time to make a statement in regard to the excursion to-morrow, details of which could not be printed in the programme in full. I have asked Mr. Brush, Chairman of the Committee of Arrangements, if he will not make a statement respecting the time of the excursion to-morrow.

W. W. Brush, M. Am. Soc. C. E.—Your Committee regrets that it could not make any announcements as to the time and place for boarding the boat to take us to the Army Base. There is a great deal of difficulty in making any arrangement for transportation this year, primarily

on account of the time of the year; and, secondly, on account of the steamboat operators' strike.

We have been fortunate, through the courtesy of Commissioner Delaney, of the Department of Plant and Structures, of the City of New York, in securing for our use the Municipal ferry-boat, *Mayor Gaynor*. The boat will be in the west slip of the Staten Island Ferry Terminal, at the foot of Whitehall Street, Battery, at any time after 9 o'clock to-morrow, Thursday morning, and will leave at 9.45. You are to enter at the street level, using the gateway which is ordinarily used for the discharge of passengers. You must not go through the Ferry Terminal in boarding the boat. The tickets which have been issued for the excursion are to be shown at the gate to the attendant.

We go from the slip to the Army Base, arriving there at about 10 A. M. Luncheon will be served at 12.15 at the Army Base. After luncheon we will board the boat, leaving the Army Base, as nearly as possible, at 1.30 P. M., and go to the Newark Bay Shipyard of the Submarine Boat Corporation, arriving there at about 2.30 P. M. The boat will return, leaving the yard at 4.30 P. M.

There will be no special train for return to the city, but, if any member desires, it is possible to come back to the city by the special workmen's trains, which run from the yard at intervals of from 12 to 15 minutes, the earliest train being at 3.48 P. M. Anybody who wishes to return by train will have to get a ticket at the yard, where they are sold regularly, and travel on this train with the workmen. I have traveled on the train, by the way, which is pretty well crowded; the boat will be much more comfortable than the train for the return trip.

It is possible to reach the Army Base by the Fourth Avenue Subway, if anybody finds it necessary to go that way. You will find no difficulty; leave the train at the Subway Station which is nearest to 58th Street, and walk three blocks westward toward the water front—where you will find the Army Base.

The time is 9.45 A. M., and the place is the Staten Island Ferry Terminal, at the foot of Whitehall Street, Battery.

THE PRESIDENT.—The report of the Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, Robert A. Cummings, Chairman.

ROBERT A. CUMMINGS, M. AM. SOC. C. E.—Mr. President and Members of the Society; on account of the war, this Committee suspended its activities during the past year, at the suggestion of the Board of Direction. It is contemplated, during the coming year, to continue the work where it left off in its last report; this will consist of the classification and definitions of soils.

This work was started three or four years ago; and questions were circulated among members of the Society, practically 10 000 letters being sent out, with the result that we received about 1% of replies.

The Committee concluded that, with the little information it had received, it was unnecessary to continue that phase of its work, because of the fact that the work could not be co-ordinated.

The Committee has practically decided upon the testing apparatus for field and laboratory work, but it is not yet ready to report on it.

The United States Bureau of Standards has been co-operating with the Committee, and the Sub-Committee of the Bureau has promised its report for the coming year. The Committee, with your consent, will continue its work.

THE PRESIDENT.—Any discussion on the Report of the Special Committee on Soils? If not, it will be accepted as a Progress Report.

The Report of the Special Committee on Stresses in Railroad Track will be presented by the Secretary.

"PROGRESS REPORT OF SPECIAL COMMITTEE TO REPORT ON STRESSES IN RAILROAD TRACK.

"The Special Committee to Report on Stresses in Railroad Track, co-operating with a similar committee of the American Railway Engineering Association, presents the following report of progress:

"The conditions incident to the war have greatly interfered with the progress of the work of the Committee. Early in the year the call to government service took away the last of the technical assistants who had become trained in this very special work. Some temporary assistance was used during the summer and fall, and it is hoped now that a small technical staff may be again developed. As the work is very special, it is not easy to get the right help, even in peace times.

"During the year the data of the tests to find the effect of counterweight of locomotive drivers, made late in 1917, on the track of the St. Louis-San Francisco Railway, have been worked upon with very interesting results. Tests were also made on the track of the Illinois Central Railroad to find the effect of counterbalance of the Mikado locomotive. Other tests were made on the Illinois Central Railroad and the Chicago, Milwaukee and St. Paul Railroad to determine the distribution of pressure immediately under the tie and also the stresses in the tie, and considerable work has been done in reducing the data.

"The Committee plans to study the results of the experimental data now available, and to take up the preparation of a report on the part of the subject so covered. It is believed, too, that sufficient information has now been accumulated to begin the discussion of the relation of the results to the principles governing the design of railroad track. It is expected, also, that the test work will be continued during the coming year.

"Respectfully submitted,
"The Special Committee to Report on Stresses in Railroad Track."

THE PRESIDENT.—Is there any discussion on this Report? If not, it will be accepted as a Progress Report.

The Report of the Special Committee on the Regulation of Water Rights will be presented by the Secretary.

THE SECRETARY.—Mr. President, this is in the form of a letter from F. H. Newell, M. Am. Soc. C. E., Chairman of the Committee.

"URBANA, ILLINOIS,
"DECEMBER 23, 1918.

"BOARD OF DIRECTION,
*"American Society of Civil Engineers,*
"33 West 39th Street, New York City.

"GENTLEMEN: The members of the Special Committee on a National Water Law have not been able to hold a meeting during 1918, because of the fact that one member, Major Hoad, was in France; another member, Mr. John H. Lewis, in Oregon; and all of us have been more than busy in connection directly or indirectly with war work. In the meantime, however, some valuable information has been collected and as normal peace conditions are resumed we expect to bring together the material with a view to presenting more definite conclusions.

"As Chairman of this Special Committee, I respectfully request that the Committee be continued for another year. I regret that it will probably be impracticable for me to attend the annual meeting, but in the event that I do not attend, I trust that this request will receive favorable consideration.

"Yours very truly,
"F. H. NEWELL."

THE PRESIDENT.—This letter may be taken as a Progress Report. If there is no discussion or action, it will be accepted as such.

Is there a Report from the Alfred Noble Memorial Committee?

THE SECRETARY.—I would like to make a very brief statement, Mr. President:

The project for the erection of the Alfred Noble Memorial has of course been held up, as stated in the Reports of the Committee published in *Proceedings,* on account of the War, but the Chairman of the Committee, Mr. Onward Bates, has asked me to state that under the present conditions the project is as much alive as ever in the minds of the Committee, and that the reasons which forced the suspension of construction of this typical Engineering Monument only add to the intensity of the desire of the Committee to complete it, and that it is the intention to proceed actively to that end when the way is open for making progress.

R. L. HUMPHREY, M. AM. SOC. C. E.—I would like to say a word with respect to the Alfred Noble Memorial—on the replica that is in Washington—and recommend to the Committee's attention the desirability of either removing it or putting it in proper order. I would like to say, further, that I pass that replica nearly every day, with many members of this Society. I have yet to hear a favorable report or opinion expressed as to the adequacy of this memorial; and I would like to call to the further attention of the Committee the desirability of reviewing the character of this memorial.

THE PRESIDENT.—There is no action necessary on that. The Report of the Committee on Development. Is Mr. Bates present? The Preliminary Report of this Committee was sent out to the membership in printed form, and has also been printed in *Proceedings.** It was hoped by the Committee that there might be a rather full discussion of the topics which were included in its report. If there is any one now who wishes to discuss this preliminary report, opportunity will be given. If not, it will be passed as a Progress Report.

"Announcements by the Secretary" is the next order of business.

THE SECRETARY.—Mr. President, the Board of Direction adopted a resolution at its meeting yesterday, based upon certain resolutions which had been adopted by the Brooklyn Engineers' Club. I will read these first.

BROOKLYN ENGINEERS' CLUB
117 REMSEN STREET
BROOKLYN, N. Y.

"*Whereas,* The Public Service Commission summarily dismissed about 350 engineering employees on December 31st effective at the close of work on that date due to action by the Board of Estimate on December 30th, and

"*Whereas,* Such action is detrimental to the best interests of the Engineering Profession and of the public generally, in that

"(*a*) The dismissal of a large number of needed employees is in complete disregard with the National Government's request at this time to keep all public work in progress in order to reduce the number of unemployed in the country due to the cessation of war industries and the return of large numbers of our soldiers from abroad;

"(*b*) The reduction in force below that necessary for proper supervision of construction work is contrary to public interest and good engineering practice;

"(*c*) The adoption of a budget arbitrarily fixing the number of engineering employees required in the conduct of the work was contrary to the recommendations of the Engineers in immediate charge of the work;

"(*d*) The treatment of these men in laying them off without notice so that their source of income is stopped immediately is reprehensible and unjust;

"(*e*) The unfair treatment of these men makes it increasingly difficult to get competent men to continue in the public service.

"In view of the preceding, it is herewith

"*Resolved.* That it is the sense of this meeting that these facts be brought to the attention of the Engineering Council of the United Engineering Societies for such action as it may deem desirable.

"The Secretary is instructed to transmit copies of this Resolution to the Secretaries of the four Engineering Societies composing the

* December, 1918, p. 1117.

United Engineering Society with the request that the matter be brought before each Society for similar action."

The following resolution was adopted by the Board of Direction on January 14th, 1919:

"The Board of Direction of the American Society of Civil Engineers, having considered the resolutions passed by the Brooklyn Engineers' Club in regard to the summary dismissal of about 350 engineer employees of the Public Service Commission, District No. 1, State of New York;

"*Resolved*, That on the statement of facts thus presented, that the dismissal of these employees, many of them specifically qualified for the difficult undertaking in which they were engaged, was not only eminently unjust and an offense to the Engineering Profession, but was directly opposed to the best interests of the City of New York, and therefore opposed to the best interests of the country;

"*Resolved*, That this Board, recognizing this to be a matter upon which the Engineering Council has properly taken prompt action, and understanding that a hearing of those directly concerned has been called for this afternoon, directs that the record of this action be filed at once with the Secretary of Engineering Council."

T. Kennard Thomson, M. Am. Soc. C. E.—Mr. President and Gentlemen; I would like to state a precedent for that. A few years ago the City of Calgary tried to discharge one of the city's engineers, under rather peculiar circumstances, on account of a bridge falling down. The Canadian Society of Civil Engineers took the matter up, and offered to make a complete investigation, and ascertain whose fault it was.

The result of that investigation was that the City of Calgary had to reappoint that engineer. I hope that Engineering Council will look after the interests of the 30 000 engineers of the National Societies.

J. V. Davies, M. Am. Soc. C. E.—I do not know that it is necessary, but I would like to move the endorsement of this Meeting of the action of the Board in drawing the attention of Engineering Council to this matter, and particularly to the fact that the construction of the work relating to rapid transit is now proceeding with no inspection supervision as to the character of the work now being carried on under contract.

(Motion duly seconded.)

The President.—It is moved and seconded that the action of the Board of Direction in passing these resolutions be approved by the Meeting. Is there any discussion on this? Those favoring this motion will say "aye"; contrary, "no". Carried.

Any further announcements?

The Secretary.—I have to announce, for the sake of the record, the election by the Board of Direction of 12 candidates as Members of this Society; of 53 candidates as Associate Members, and of 6 Juniors,

and the transfer of 15 Associate Members to the grade of Member, 1 Associate to the grade of Associate Member, and of 15 Juniors to the grade of Associate Member. I have all the names here.*

THE PRESIDENT.—It is not necessary to read them unless they are called for.

THE SECRETARY.—I have received one or two letters which may be of interest to the Meeting.

"NEW YORK, 290 BROADWAY,
"DECEMBER 27, 1918.

"MR. CHAS. WARREN HUNT,
*Secretary, American Society of Civil Engineers,*
33 West 39th St., New York City.

"DEAR MR. HUNT:—We are at present constructing the pneumatic foundations for the U. S. Assay Office at Wall and Broad Sts., New York City, and it occurred to us that this construction work might be of interest to some members of the Society at the time of the Annual Meeting.

"We will be very glad to welcome any members of the Society who care to see this work. The work is in an interesting stage at present, the caissons are to be of concrete in the form of a continuous coffer-dam to rock enclosing the gold vault for the Assay Office. Some of the caissons will be concreted standing 30 ft. above ground, while others will be in the course of sinking, so that it will be instructive to those who are not familiar with this class of work.

"If you decide to put this work on your schedule, we will be glad to have guides available for directing the party to the work.

"Yours very truly,
"THE UNDERPINNING & FOUNDATION CO.
"FRANCIS L. PRUYN,
*"Vice-President."*

"50 CHURCH STREET, NEW YORK,
"DECEMBER 27, 1918.

"DR. CHARLES WARREN HUNT,
*"Secretary, Am. Soc. C. E.*
33 West 39th St.

"DEAR DR. HUNT: The foundations for the New Assay Building on Wall St. ought to be at a very interesting stage at the time of our annual meeting, so, if any of our members care to visit the site, I am sure that the Government Superintendent, Mr. B. A. Appleyard; Chas. T. Wills Co. General Contractors; The Underpinning Foundation Co., and myself will be glad to give any information possible. The work consists of underpinning the old Sub Treasury and Gallatin Bank Buildings now completed and construction of new vaults 30 feet below the ground water surface by means of six pneumatic caissons, 8 feet wide and from 20 to 26 feet long, and two of 5 feet 6 inches in width.

* See page 118.

"These caissons will be entirely of reinforced concrete, and the various stages of the work should then be in operation. There will also be six smaller square caissons for foundations for the building.

"The deep cellar portion will contain nothing but the vaults, and will be so arranged as to have a passageway all around the vaults and a clear space under the vaults which will always be open to observation from the upper floor by means of inclined mirrors at the bottom of the passageways—or spaces between the side walls and the vaults.

"The original plans were made by Col. J. Hollis Wells, member of the American Society of Civil Engineers, for the Government.

"Yours respectfully

"T. KENNARD THOMSON,
*"Consulting Engineer for the Supervising Archt. of the Treasury Dept."*

THE SECRETARY.—These letters, however, were not received in time to add this feature to our regular programme; and I simply make this announcement so that Members who are interested in that work can take advantage of it.

I have a letter, also, from Daniel H. Cox, Manager of the Division of Steel Ship Construction, also signed by R. J. Wig, Head of the Concrete Ship Section.

"140 NORTH BROAD STREET,
"PHILADELPHIA, PA.,
"DECEMBER 31ST, 1918.

"MR. CHARLES WARREN HUNT,
*Secretary, American Society of Civil Engineers,*
33 West 39th Street, New York City.

"DEAR SIR: We have received a number of inquiries of late from engineers desiring to inspect one of our concrete ships under construction. There are several of them who will be in attendance at the annual meeting of the Society.

"We have under construction in the yard of the Fougner Shipbuilding Company, Flushing Bay, N. Y., a 3 500-ton concrete ship, the hull of which is practically complete, and it is anticipated that this ship will be launched early in February.

"It has been suggested that you might wish to extend a general invitation to all members of the Society and possibly have a special excursion to inspect this boat. I would be very glad to extend such an invitation to all members.

"Very truly yours,

"DANIEL H. COX,
*"Manager, Div. of Steel Ship Construction.*
"By R. J. WIG.
*"Head, Concrete Ship Section."*

THE SECRETARY.—I have to announce, Mr. President, the following deaths:*

* See page 120.

THE PRESIDENT.—The next in order is "New Business". Has any Member any business to present to the Meeting?

R. S. BUCK, M. AM. SOC. C. E.—Mr. President and Gentlemen; you all doubtless have already realized the fact that the question of unemployment is already acute, and becoming more so. After discussing the matter with some of the members of the Society, it is proposed that certain resolutions at this Meeting might carry weight in abating the difficulty that is ahead of us in this regard. Therefore, I would like to present the following resolutions:

"*Whereas,* It is vital to the peace and welfare of our country that, during the necessary reconstruction period following the war, the number of unemployed be reduced as much as possible; and

"*Whereas,* The development of transportation, sanitation, power, and public utilities generally is necessary to the development and prosperity of the country; and

"*Whereas,* The curtailment of needed public works during the period of the war has retarded the development of the country; and

"*Whereas,* The speediest and most effective means to prevent the suffering, distress, and demoralization resulting from unemployment is afforded by public works; and

"*Whereas,* The public welfare and confidence, upon which industry generally depends, require that the construction of public works be vigorously prosecuted; therefore, be it

"*Resolved,* That the American Society of Civil Engineers, assembled in their Sixty-sixth Annual Meeting, this fifteenth day of January, 1919, desires to record its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons, but for humanitarian reasons, to furnish employment for all who can properly claim employment, especially returning soldiers; and be it further

"*Resolved,* That copies of this resolution be forwarded to such Federal, State, and municipal authorities as may be able, in the opinion of the Executive Committee of the Board of Direction of the Society, to promote the purposes of these resolutions."

THE PRESIDENT.—The resolutions have been presented; what action shall be taken?

(Motion duly seconded.)

THE PRESIDENT.—The motion has been made and seconded that the resolutions be adopted by the Annual Meeting. Is there any discussion on this? If not, those favoring the motion to adopt these resolutions will say "aye"; contrary, "no". It is carried.

Is there any further new business?

M. O. LEIGHTON, M. AM. SOC. C. E.—May I be allowed a few minutes to make an announcement?

THE PRESIDENT.—We should be glad to have you do so.

Mr. Leighton.—Mr. President and Gentlemen; in the last *Proceedings* of the Society you probably noted that Engineering Council was contemplating, and, in fact, had approved, a tentative plan presented by Mr. Philip N. Moore to organize a National Service Committee, with headquarters in Washington, D. C.; and the functions of that Committee, so far as they can be foretold and planned at the present time, were set forth in the *Proceedings*.

Although no public announcement has been made of the final action of Engineering Council, no secret has been made of the fact that the National Service Committee has been organized, and its office at the present time is open in Washington and is endeavoring to do such preliminary business as it can, prior to formal announcement and prior to the acceptance of election by all the members who were appointed by Engineering Council.

The speaker has been honored by selection as Chairman of that Committee. There is a very large amount of work to be done, and there is a very large amount of work to be avoided. It is realized that this Committee is going to be very successful, or it is going to be a very great nuisance, and that the principal difficulty at the present time is to determine what shall be selected, out of the great mass of obvious things, to be done first.

The Committee is entirely dependent on this and the other Founder Societies. It is entirely dependent on the individual membership of those societies. We must make use of you, as we hope that sometime you will be able to make productive and satisfactory use of us; but we would like to have you understand that though this is a Committee directly of Engineering Council, it is nevertheless your Committee. We need your help, we need your suggestions. If you can think of any way by which this Committee can be made of service, please address the Committee accordingly.

You know there is a heap of loose thinking going on about the world just now; and the help of engineers and the engineer's habits of thought are exceedingly essential to our progress and to our welfare. This National Service Committee hopes to act for you in this way. You will receive announcements from time to time of work and progress; but we hope that in the meantime you will be thinking, that you will be sending to us letters with suggestions, and taking part to the utmost in the progress of this Committee's work. I thank you, Mr. President.

The President.—The chair wishes to say that it believes that the appointment of Mr. Leighton as Chairman of this Committee, with his long residence in Washington and his experience with governmental matters, is starting the Committee under very favorable auspices; and he hopes that the members of the Society will do everything in their power to help the Committee from time to time.

Is there anything further in the way of new business? Does Mr. Hansel wish to take up the point which he made earlier in the Meeting?

Mr. Hansel.—Mr. President, we have just heard of the efforts to do something in Washington, and I would like to know how they are going to finance the work. It occurs to me that this Society and the others of the Founder Societies should be represented in Washington, not only by the genius of the engineer, but by the support of such finances as will enable them to entertain cabinet officers, ambassadors, all the big men that come to Washington. I want to see our Society at Washington able to do at least as great things in the general upbuilding of the country as the other societies.

Now, I understand that our funds are quite low, and it occurs to me that it needs no sacrifice at all for the four Founder Societies to subscribe at least $5 each member, and others who feel that they can do better will no doubt do so.

Now, I realize that you are operating through the United Engineering Society. Of course, I understand that. I do not belong to that Society. I have been asked why I do not, and I answer that the United Engineering Society is a clearing house, as it were, for the things before the four Founder Societies.

Now, if it is in order, I should like to offer a resolution that it is the sense of this Meeting that the four Founder Societies join in asking their Members for a subscription of a minimum of $5 each, to be handled as best seems fit by Engineering Council.

A Member.—I second the motion, Mr. President, to get it before the Meeting.

The President.—The motion is made and seconded that it is the sense of this Meeting that the four Founder Societies should join in asking subscriptions from the Members of $5 each—I believe that was the sum named—to provide funds for its special services. Is there any discussion on this?

Mr. Leighton.—Mr. President, as Mr. Hansel asked a question at the outset of his remarks concerning the support of the Washington office, perhaps you would like to know, before you vote on that motion, that this office in Washington is, for the present, at least, to be supported by a saving, or a residue, of the appropriation made to Engineering Council for the year 1918. Something like $2 500 or $3 000 that the Council saved, or did not spend, is to be re-appropriated for the support of the office in Washington during 1919.

Of course, that makes a rather small amount for support. It provides for a modest staff; and perhaps it was well that no more money was available, because it made a modest start necessary. The history of such movements in Washington usually has been that they have started with a blast of trumpets, spread themselves over the whole floor of an office building, and in a short time shrunk away to a grease spot.

Engineering Council did not want this to happen. It is expected that at some proper time in the future, when this movement grows, we shall need a lot more money; and the $5 subscription from the Members of all the Founder Societies will be very welcome; but, for the present, at least, the amount that is available for the support of the Washington office is coming from what Engineering Council saved last year.

C. J. Tilden, M. Am. Soc. C. E.—Mr. President, I should like to know just where this office is located in Washington, and just what this Committee is now doing.

The President.—Will Mr. Leighton give the information?

Mr. Leighton.—The office is at No. 502 McLachlen Building, which is on the corner of Tenth and G Streets, N. W.

The Committee has not yet had any meetings, because all the nominees have not yet accepted membership. The chairman has sent letters, to the members who have accepted membership, enclosing copies of the tentative plans of Mr. Philip N. Moore and asking those members if they would criticise them, make additional suggestions, and prepare themselves to come to a preliminary meeting.

The Chairman of the Committee at the present time is wondering just what he ought to do next, and he has come to this Annual Meeting of the American Society of Civil Engineers largely for the purpose of finding out. You see, I am very frank about it. This job is so big, it has so many ramifications, that I am free to confess I do not know what should be done next, and until I have a chance to orient myself and get some suggestions from the members of the Committee, and especially from the members of the Society, I am not sticking out my chest very much.

Mr. Davies.—Before this motion is put, Mr. Chairman, I would like to ask for some information. I am very close up, but I declare I do not know a thing about what the motion is for, excepting that we are to be asked for $5. I am sure many in the room, and especially those in the rear of the room, have less idea than I have about what it is for.

Personally, I think it is an improper proceeding to come to this Meeting and request the other National Societies to put up $5 per member. I have no objection to using that money for any proper purpose, but I do not see, and I do not understand, what is to be done with it when it is obtained.

The President.—Will the maker of the motion make that clearer?

W. H. Wiley, M. Am. Soc. C. E.—I move that the motion be laid on the table.

(Motion duly seconded.)

THE PRESIDENT.—A motion is made to lay the motion on the table, which has been seconded. Those favoring the motion will say "aye"; contrary, "no". It is carried.

THE PRESIDENT.—I am not sure, gentlemen, that that does not mean that you may not be asked for money for such a cause at some time in the future. Is there any further business to be presented? If not, we will have the report of the tellers on the election of officers for the ensuing year.

(The Secretary read the Report of the Tellers, as follows:)

"33 WEST 39TH ST.,
"NEW YORK, N. Y.
"JANUARY 15, 1919.

"TO THE SIXTY-SIXTH ANNUAL MEETING
AMERICAN SOCIETY OF CIVIL ENGINEERS:

"The Tellers appointed to canvass the ballots for Officers of the Society for 1919 report as follows:

| | | |
|---|---|---|
| "Total number of ballots received | | 1481 |
| Ballots without signature | 19 | |
| " stamped, not signed | 37 | |
| " from members in arrears of dues | 11 | |
| Total number not entitled to vote | | 67 |
| Ballots canvassed | | 1414 |
| Defective | | none |

*"For President:*

| | |
|---|---|
| FAYETTE SAMUEL CURTIS | 1405 |
| Scattering | 6 |

*"For Vice-Presidents:*

| | |
|---|---|
| HERBERT SAMUEL CROCKER | 1398 |
| LEONARD METCALF | 1385 |
| Scattering | 8 |

*"For Treasurer:*

| | |
|---|---|
| ARTHUR SMITH TUTTLE | 1411 |
| Scattering | 1 |

*"For Directors:*

| | | |
|---|---|---|
| District No. 1 | GEORGE HALLETT CLARK | 1387 |
| | JACOB STINMAN LANGTHORN | 1381 |
| | Scattering | 5 |
| District No. 2 | CHARLES CLEMENT ELWELL | 1368 |
| | Scattering | 1 |
| District No. 6 | WILLARD BEAHAN | 1362 |
| | Scattering | 5 |

| | | |
|---|---|---|
| District No. 8 | JOHN WATSON ALVORD | 1367 |
| | Scattering | 4 |
| District No. 13 | CARL EWALD GRUNSKY | 1348 |
| | Scattering | 14 |

"PHILIP P. FARLEY, *Chairman,*
J. W. F. BENNETT,
ALBERT S. CRANE,
JAMES W. NELSON,
EDWIN J. ROSENCRANS,
BERTRAND H. WAIT,
CHARLES U. POWELL,
*"Tellers."*

THE PRESIDENT.—The Members, whose names have been read, having the highest votes for these respective offices, are declared elected officers of the Society for the ensuing term.

Before asking the new President to come forward, I wish again to express to the Members my great appreciation of the honor conferred upon me, and the confidence put in me, in electing me President of the Society. I wish to say, too, that I have very much enjoyed the work with the Board of Direction, and I shall always value the honor thus conferred upon me.

Will Past-President Herschel and Past-President Stearns escort Mr. Curtis, the President-Elect, to the platform,

Mr. Curtis, I wish to greet you as the fiftieth President of the American Society of Civil Engineers.

FAYETTE SAMUEL CURTIS, PRESIDENT, AM. SOC. C. E.—Members of the American Society of Civil Engineers, at this time I do not care to inflict upon you any remarks of my own, although possibly admissible; all that I have to say is that I thank you for the honor conferred upon me in electing me President of this Society.

THE SECRETARY.—The only announcement I think it is necessary to make is that luncheon will be ready at 1 o'clock, on the 5th floor, and that members of the Board of Direction are asked, immediately upon adjournment of this Meeting, to go to the 16th floor, where, in the Past-Presidents' room, a meeting of the Board of Direction will be held and where luncheon will be served to them.

THE PRESIDENT.—You have heard the notice given to you by the Secretary. Please take notice and govern yourselves accordingly.

If there is no other business, gentlemen, I declare the Business Meeting adjourned.

## EXCURSIONS AND ENTERTAINMENTS AT THE SIXTY-SIXTH ANNUAL MEETING

**Wednesday, January 15th, 1919.**—After the Business Meeting, in the Auditorium of the Engineering Societies Building, lunch for about 650 members was served.

At 3 P. M. Brig.-Gen. R. C. Marshall, Jr., Chief of Construction Division, U. S. A., addressed the Society on "The Construction Work Carried on in the United States During the War", illustrating his remarks with lantern slides. About 600 members were present.

At 9 P. M. there was a Reception to the President, in the large ballroom of The Biltmore, at which there was an attendance of about 350 members and guests.

**Thursday, January 16th, 1919.**—The day was devoted to an excursion to the Brooklyn Army Supply Base, by invitation of the Construction Division, U. S. A., Col. H. S. Crocker, M. Am. Soc. C. E., in charge; and to the Newark Bay Shipyard of the Submarine Boat Corporation.

The excursion was made on the Municipal Ferry-boat *Mayor Gaynor*. The boat, carrying about 750 members and guests, left the slip at the foot of Whitehall Street at 10 A. M. and proceeded at once to the Army Base. After inspecting the docks, pier sheds, terminal yards, and the large reinforced concrete warehouses, the party was entertained at luncheon by the Turner Construction Company, the general contractors for the project. The party then re-embarked and proceeded to the Newark Bay Shipyard, where the afternoon was spent in inspecting the extensive plant and the numerous ships under construction. The party returned by the steamer to New York, arriving at about 7 P. M.

During the afternoon a party of about 20 members accepted the invitation of the Fougner Shipbuilding Company to visit their yard at Flushing and inspect a large concrete ship under construction.

At 8.30 P. M., in the Auditorium, Brig.-Gen. S. T. Ansell, Acting Judge Advocate General, U. S. A., delivered an address on the war and the American soldier. At this function about 650 members were present, and, following it, there was a social and informal Smoker, at which the attendance was about 750.

The following list contains the names of 933 members of various grades who registered as being in attendance at the Annual Meeting. The list is incomplete, as some members failed to register, and it does not contain the names of any of the guests of the Society or of individual members. It is estimated that the total attendance was about 1 200.

Abbot, F. V....Washington, D. C.
Abbott, C. P..White Plains, N. Y.
Adams, E. G.....New York City
Aertsen, G.....Philadelphia, Pa.
Aiken, W. A.....Pottstown, Pa.
Aikenhead, J. R...New York City

Aims, W. I.....New York City
Alderson, A. B.,
West Hartford, Conn.
Alexander, A.....New York City
Alexander, H. J...New York City
Allaire, A.....New York City
Allaire, D. A.....Brooklyn, N. Y.
Allen, C. F.....Boston, Mass.
Allen, E. Y.....New York City
Allen, F. W....Mt. Vernon, N. Y.
Allen, H. D.....Newark, N. J.
Allen, K.....New York City
Alvord, J. W...Washington, D. C.
Ammann, O. H.,
South Amboy, N.J.
Anderberg, E.....New York City
Anderson, R. H...New York City
Anderson, W. T...New York City
Andrews, G. C.....Buffalo, N. Y.
Andrews, H. S..Mt. Vernon, N. Y.
Archer, A. R.....New York City
Armstrong, A. F....Albany, N. Y.
Armstrong, W. R...Omaha, Nebr.
Arnston, J. A.Perth Amboy, N. J.
Ashbaugh, L. E....New York City
Ashmead, P. H....New York City
Atkinson, A.New Brunswick, N. J.
Atwater, H. C.....New York City
Atwood, T. C.....Baltimore, Md.
Auryansen, F.....Jamaica, N. Y.
Austin, W. E.....New York City
Auten, C. I....Youngstown, Ohio

Babcock, W. S.....New York City
Bailey, A. R.....New York City
Baker, F. A.....Newark, N. J.
Baldwin, W. J.....New York City
Ballinger, W. F..Philadelphia, Pa.
Bamford, W. B.....Belmar, N. J.
Baptiste, E. E...Jersey City, N. J.
Barnett, R. P.....New York City
Barney, P. C.....New York City
Barney, S. E.....New York City
Bascome, W. R....New York City
Basinger, J. G....New York City
Bass, F. H....Minneapolis, Minn.
Bassett, W. M....Worcester, Mass.
Baucus, W. I..San Pedro de
Macoris, Dominican Republic
Baughman, C. A..Hog Island, Pa.
Beahan, W.....Cleveland, Ohio
Bean, E. D.....Bridgeport, Conn.
Bean, G. L.....Philadelphia, Pa.
Bear, E. R.....Wheeling, W. Va.
Becker, R. C.....New York City
Beekman, J. V., Jr..Boston, Mass.
Beggs, G. E.....Princeton, N. J.
Belknap, F. W....New York City
Belknap, J. M...Manhasset, N. Y.
Belzner, T.....New York City
Bennett, J. W. F...New York City
Bensel, J. A.....New York City
Berger, B.....New York City
Beswick, J. E.,
New Brighton, N. Y.
Bettes, C. R..Far Rockaway, N. Y.
Betts, R. T.....New York City
Bigelow, W. W.....Boston, Mass.
Bilyeu, C. S.....New York City
Bixby, W. H.....Chicago, Ill.
Blair, C. M....New Haven, Conn.
Blakeslee, C....New Haven, Conn.
Blanchard, A. H...New York City
Blanchard, R. K...New York City
Bleistein, B. J.....Astoria, N. Y.
Blodgett, J.....New York City
Boardman, C. S....Buffalo, N. Y.
Boardman, H. E..New York City
Boardman, H. S.....Orono, Me.
Boardman, W. H...Newark, N. J.
Bogart, John.....New York City
Bogert, C. L.....New York City
Bond, E. A.....New York City
Boniface, A.....New York City
Bontecou, D.....New York City
Boorman, K. M....New York City

Borough, E. W....Brooklyn, N. Y.
Bouton, H. R.....New York City
Bower, C. P.....Philadelphia, Pa.
Bowlby, H. L...Washington, D. C.
Brackenridge, J. C.New York City
Bradley, F. E.....New York City
Bramwell, G. W...New York City
Breitzke, C. F.....Boonton, N. J.
Brennan, J. L.....New York City
Breuchaud, J.....New York City
Brewer, B.....Waltham, Mass.
Bronson, H. F...Riverhead, N. Y.
Brooks, J. P.....Potsdam, N. Y.
Brower, I. C....Washington, D. C.
Brown, B. S.....Boston, Mass.
Brown, L. F.....New York City
Brown, T. E.....New York City
Brown, W. E.....Brooklyn, N. Y.
Brown, W. N..Washington, D. C.
Brush, W. W.....New York City
Buck, H. R.....Hartford, Conn.
Buck, R. S.....New York City
Buehler, W.....Chicago, Ill.
Buettner, O. G. H..New York City
Burgess, G. H.....Albany, N. Y.
Burpee, M.....Houlton, Me.
Burr, W. H.....New York City
Burrowes, P. de N....Russell, Va.
Bush, A. L.....Philadelphia, Pa.
Bush, H. D.....Baltimore, Md.
Bush, L.....Washington, D. C.
Byers, B. B. F.....Baltimore, Md.

Cadwallader, W. L.New York City
Cahn, E.....New York City
Campbell, C. C.,
Camp Merritt, N. J.
Carmalt, L. J..New Haven, Conn.
Carpenter, C. E...New York City
Carpenter, F. W..Cornwall, N. Y.
Carstarphen, F. C..Trenton, N. J.
Casani, A. A.....Pittsburgh, Pa.
Castle, S. N.....New York City
Castleman, F. L.....Pencoyd, Pa.
Cerny, J. W.....Brooklyn, N. Y.
Chace, I. M., Jr.,
New Bedford, Mass.
Chappell, C. E.,
Camp Humphreys, Va.
Chase, C. E..Poughkeepsie, N. Y.
Chase, C. F...New Britain, Conn.
Chase, J. C..Derry Village, N. H.
Chase, R. D.....New York City
Chorlton, W. H....New York City
Christian, G. L....Yonkers, N. Y.
Cilley, M.....New York City
Clapp, S. K...Grand Gorge, N. Y.
Clark, A. E.....New York City
Clark, G. H.....New York City
Clark, W. G.....New York City
Clarke, E. W.....Flushing, N. Y.
Clarke, G. C.....New York City
Clarke, St. J.....Bogota, N. J.
Class, C. F.....Harrisburg, Pa.
Closson, W. G....Brooklyn, N. Y.
Cobb, L. R.....New York City
Cochrane, V. H.Washington, D. C.
Codwise, H. R....Brooklyn, N. Y.
Coffin, T. De L....Katonah, N. Y.
Cohen, A. B...East Orange, N. J.
Cohen, C.....New York City
Cole, C. L.....Meriden, Conn.
Cole, E. S.....New York City
Cole, G. N.....New York City
Cole, H. J.....Washington, D. C.
Coleman, J. F.....Mobile, Ala.
Collier, B. C.....Allentown, Pa.
Collins, A. L....Santa Cruz, Cal.
Collins, C. D.....New York City
Collins, T. E.....Elizabeth, N. J,
Colyer, C. I.....Montclair, N. J.
Conard, W. R....Burlington, N. J.
Conger, A. A.....Worcester, Mass.
Conklin, C. D., Jr.Cheltenham, Pa.
Connelly, J. A. A..New York City
Constable, H. ....Kingston, N. Y.

Constant, F. H...Princeton, N. J.
Cooksey, R. M.....Baltimore, Md.
Cooley, M. E....Ann Arbor, Mich.
Coombs, A. W.....New York City
Coombs, S. E.....New York City
Cornell, J. N. H...New York City
Cornell, J. W.....Brooklyn, N. Y.
Covert, C. C.....Albany, N. Y.
Crane, A. S.....New York City
Craven, A. S....Philadelphia, Pa.
Creager, W. P.....New York City
Crellin, E. W.....Pittsburgh, Pa.
Cresson, B. F., Jr.New York City
Cresson, J.....Norristown, Pa.
Creuzbaur, R. W.Philadelphia, Pa.
Crider, J. L.Mount Vernon, N. Y.
Critchlow, H. T....Trenton, N. J.
Crocker, H. S....Brooklyn, N. Y.
Crooks, C. H.....New York City
Cross, H.....New York City
Crowell, F. S.....New York City
Cuddeback, A. W..Paterson, N. J.
Culgin, G. W.....New York City
Cullen, J. F.....Philadelphia, Pa.
Cullings, E. S.....Albany, N. Y.
Culyer, T. C.....Mt. Kisco, N. Y.
Cummings, R. A..Pittsburgh, Pa.
Cummings, R. A., Jr.,
Pittsburgh, Pa.
Cummins, C. A....Baltimore, Md.
Curtis, C. E.....Ithaca, N. Y.
Curtis, F. S.....Boston, Mass.
Curtis, V. P.....Worcester, Mass.

Daggett, F. W.....Trenton, N. J.
Dailey, J. A...East Orange, N. J.
Dakin, A. H., Jr...New York City
Darling, W. L.....St. Paul, Minn.
Darville, M. A.....New York City
Davies, J. V.....New York City
Davis, A. L.....New York City
Davis, A. P....Washington, D. C.
Davis, B. H.....New York City
Davis, C. E.....Philadelphia, Pa.
Davis, J. L..Mount Vernon, N. Y.
Day, E. B.....New York City
Degnon, N. G.....Jamaica, N. Y.
Deiser, N. A.....Brooklyn, N. Y.
Delson, I.....Stapleton, N. Y.
Desmond, T. C....New York City
Develin, R. G...Philadelphia, Pa.
Devlin, H. S.....Harrisburg, Pa.
De Witt, P. H.East Orange, N. J.
Deyo, S. L. F.....New York City
Diebitsch, E.....New York City
Dimon, D. Y.....Passaic, N. J.
Dingman, C. F.....Palmer, Mass.
Doeleman, H. F...Baltimore, Md.
Donham, B. C.....New York City
Donnelly, A. L.New Haven, Conn.
Doron, C. S.....New York City
Dorrance, W. T.New Haven, Conn.
Dougherty, R. E.,
White Plains, N. Y.
Doyen, G. E.....New York City
Dresser, G. L.....New York City
Dufour, F. O.....Boston, Mass.
Dunham, H. F....New York City
Dunham, W. R., Jr.,
New Haven, Conn.
Dunn, H. L...New London, Conn.
Dutton, C. H....Providence, R. I.
Dykeman, C. F....Brooklyn, N. Y.

Earle, T.....Bethlehem, Pa.
Eckersley, J. O....New York City
Eddy, H. P.....Boston, Mass.
Eden, A. W. A....New York City
Edwards, D. G....Brooklyn, N. Y.
Edwards, L. N.,
Toronto, Ont., Canada
Edwards, W. R.Washington, D. C.
Ehle, B.....Yonkers, N. Y
Eide, T.....New York City
Ellendt, J. G.....New York City
Elwell, C. C....New Haven, Conn.

English, H. L. . Washington, D. C.
Evers, R. . . . . Brooklyn, N. Y.
Ewing, W. W. . . . . Cranford, N. J.

Farley, J. M. . White Plains, N. Y.
Farley, M. M. . Camp Shelby, Miss.
Farley, P. P. . . . . New York City
Farnham, A. B. . . Pittsfield, Mass.
Farnham, R. . . . . Philadelphia, Pa.
Farrington, H. P. . New York City
Fay, F. H. . . . . Boston, Mass.
Federlein, W. G. . . New York City
Feiner, M. A. . . . . New York City
Fellows, F. J. . . . . Hollis, N. Y.
Ferguson, J. N. . . . . Boston, Mass.
Ferguson, J. W. . . . Paterson, N. J.
Ferguson, W. E.,
Hastings-on-Hudson, N. Y.
Fetherston, J. T.,
Muscle Shoals, Ala.
Files, T. H. . . . . New York City
Fisher, E. A. . . . . Rochester, N. Y.
Fitzgerald, W. E.,
New Brunswick, N. J.
Fitzmaurice, E. J.,
Philadelphia, Pa.
Fleischmann, L. . . . New York City
Fletcher, R. . . . . Hanover, N. H.
Flinn, A. D. . . . . New York City
Forbes, F. B. . . . . New York City
Ford, F. L. . . . . New Haven, Conn.
Ford, W. H. . . . . Philadelphia, Pa.
Forgie, J. . . . . New York City
Forrest, C. N. . . . . Maurer, N. J.
Forster, A. O. . . . . Brooklyn, N. Y.
Foss, F. E. . . . . New York City
Foster, E. H. . . . . New York City
Fowler, C. E. . . . . New York City
Fox, W. F. . Rockville Center, N. Y.
Francis, H. N. . . Providence, R. I.
Frank, A. H. . . . . Brooklyn, N. Y.
Frankland, F. H. . . New York City
Franklin, B. . . . . Philadelphia, Pa.
Franklin, C. M. Mt. Vernon, N. Y.
Fraser, C. E. . . . . New York City
Fraser, E. A. . . . . New York City
Fraser, R. M. . . . . Rome, N. Y.
Freeman, J. R. . . Providence, R. I.
Freeman, M. H. . . Brooklyn, N. Y.
French, A. W. . . . Worcester, Mass.
French, H. . . . . New York City
French, J. B. . . . . New York City
Fry, A. B. . . . . Brooklyn, N. Y.
Fuller, A. H. . . . . Easton, Pa.
Fuller, W. E. . . . . New York City
Furber, W. C. . . . Philadelphia, Pa.

Gallogly, A. V. . . . . New York City
Gardiner, F. W. . . . New York City
Gardiner, J. deB. W.,
New York City
Gardner, H. C. . . . . Lancaster, Pa.
Gardner, W. . . . . New York City
Garfield, C. A. . . Bronxville, N. Y.
Gaston, L. P. . . . . New York City
Gausmann, R. W. . New York City
Gibbs, G. . . . . New York City
Giesey, J. K. . . . . New York City
Gifford, G. E. . . . . New York City
Gildersleeve, G. S. . New York City
Giles, J. A. . . . . Binghamton, N. Y.
Gillespie, R. H. . . . New York City
Gillette, E. . . . . Sheridan, Wyo.
Gilman, C. . . . . New York City
Ginsburg, S. R. . . . New York City
Goldbeck, A. T. Washington, D. C.
Goldmark, H. . . . . New York City
Goldsborough, J. B. New York City
Goodman, L. . . . . New York City
Goodwin, R. E. . Weehawken, N. J.
Gould, C. M. . . . . New York City
Gould, R. R. . . . . New York City
Gould, W. T.,
Hastings-on-Hudson, N. Y.
Gowen, S. . . . . Phœnixville, Pa.
Grant, K. C. . . . Washington, D. C.

Greenalch, W.....Albany, N. Y.
Greene, G. S., Jr..New York City
Greene, R. de C...New York City
Greenfield, R. A.Mt. Vernon, N. Y.
Gregory, C. E....Mt. Kisco, N. Y.
Gregory, J. H....Montclair, N. J.
Greiner, J. E.....Baltimore, Md.
Griest, M.....New York City
Griffin, G. A.....Philadelphia, Pa.
Griggs, T. G.....Elizabeth, N. J.
Grimes, J. E.....Aberdeen, Md.
Grove, W. G.....New York City
Grover, O. L....Washington, D. C.
Grunsky, C. E.San Francisco, Cal.
Gutman, D.....Pelham, N. Y.

Haggart, C. N.....Narberth, Pa.
Haines, E. G.....New York City
Hale, H. M.....New York City
Hall, M. W.....New York City
Hall, R. F.....Utica, N. Y.
Halsey, W. H.Southampton, N. Y.
Hamilton, J. W....New York City
Hammel, E. F.....New York City
Hammond, G. T..Brooklyn, N. Y.
Hammond, H. P..Brooklyn, N. Y.
Hammond, L. C...New York City
Hansel, C.....New York City
Harby, I.....New York City
Harding, H. S.....Hollis, N. Y.
Haring, A.....New York City
Harper, J. L.Niagara Falls, N. Y.
Harps, H. M..Perth Amboy, N. J.
Harris, B. B.....New York City
Harte, C. R....New Haven, Conn.
Hartmann, E. F...New York City
Harwi, S. J.....Bayonne, N. J.
Haskell, E. E.....Ithaca, N. Y.
Haskins, W. J.....New York City
Hauck, W.....New York City
Havens, V. L..Washington, D. C.
Hawgood, H.....Los Angeles, Cal.
Hawkins, G. L....Elizabeth, N. J.
Hayes, R. D.....Stillwater, N. Y.
Haywood, C. E....New York City
Hazen, A.....New York City
Hazen, W. N.....Orange, N. J.
Heatley, T.....New York City
Heckle, G. R.,
Montreal, Que., Canada
Heerlein, R. W....New York City
Heinonen, H. J..Philadelphia, Pa.
Heiser, A. B.....Brooklyn, N. Y.
Heiser, W. J.....Brooklyn, N. Y.
Heller, J. W. South Orange, N. J.
Hellyer, H. A. C....Tenafly, N. J.
Henderson, A. R.Jersey City, N. J.
Henry, P. W.....New York City
Hering, R.....New York City
Hermanns, F. E..Brooklyn, N. Y.
Heyman, W.....Jersey City, N. J.
Higgins, C. H.....New York City
Higgins, J. W.....New York City
Hilton, J. C.....Brooklyn, N. Y.
Hilts, H. E.....Philadelphia, Pa.
Hingsburg, F. C.,
San Juan, Porto Rico
Hinrichs, A.....Brooklyn, N. Y.
Hirsch, H. D.....New York City
Hirsch, J. G.....Philadelphia, Pa.
Hirst, A.....New York City
Hitchcock, F. C....New York City
Hodgdon, B. A.East Orange, N. J.
Hodgdon, F. W..Arlington, Mass.
Hoerner, C. G., Jr.Phoenicia, N. Y.
Holbrook, A. R....New York City
Holbrook, J. B....New York City
Holbrook, P.....New York City
Holbrook, W..Garden City, Kans.
Holden, C. A.....Hanover, N. H.
Holland, C. M....Brooklyn, N. Y.
Hollyday, R. C....Brooklyn, N. Y.
Horton, R. E.....Albany, N. Y.
Hough, D. L.....New York City
Hovey, O. E.....New York City

Howe, C. E.,
Hastings-on-Hudson, N. Y.
Hoyt, W. H.....Duluth, Minn.
Hughes, J. W.....Erie, Pa.
Huie, I. V. A.....New York City
Hulbert, E. C.....Wampum, Pa.
Hulsart, C. R.....New York City
Hulse, S. C.....Bedford, Pa.
Humphrey, R. L. Philadelphia, Pa.
Hunt, C. E.....New York City
Hunt, Chas. Warren,
New York City
Hunt, W. H.....Brooklyn, N. Y.
Hurd, H. L.....New York City
Hurlbut, C. C....Montclair, N. J.
Hurlbut, H. B..Washington, D. C.
Hutchins, E.....New York City
Hutchinson, F. D..New York City
Huttenloch, M. W. Montclair, N. J.
Hyatt, C.....New York City
Hyde, H. E.....Ithaca, N. Y.
Hyman, A. D....New York City
Hyman, H. A....New York City

Ilsley, A. B.....Charlotte, N. C.
Immick, H. D....New York City
Irwin, J. C.....Boston, Mass.

Jackson, J. F..New Haven, Conn.
Jacobs, R. H.....New York City
Joachimson, M....New York City
Johannesson, S....New York City
Johnson, G.....Boston, Mass.
Johnson, G. A..Washington, D. C.
Johnson, N. C....New York City
Johnston, J. A..Springfield, Mass.
Jones, H. L.....New York City
Jones, S. R.....New York City
Jordan, L. C....Morsemere, N. J.
Joslin, H. V.....New York City

Kaestner, A. C....New York City
Kalberg, S. A...Springfield, Mass.
Kaufman, G.....New York City
Keays, R. H....Jersey City, N. J.
Keefer, C. H. Ottawa, Ont., Canada
Keith, H. C.....New York City
Keller, O. B.....New York City
Ketchum, M. S.....Boulder, Colo.
Khuen, R., Jr....Pittsburgh, Pa.
Kimball, F. C.....Summit, N. J.
Kinsey, W. A....Newark, N. J.
Kirkwood, H. C...Flushing, N. Y.
Kittredge, G. W...New York City
Knight, E. K.....New York City
Knight, H. M....Montclair, N. J.
Knighton, J. A....New York City
Knowles, Morris...Pittsburgh, Pa.
Knox, S. B.....New York City
Kornfeld, A. E....New York City
Kraus, A.....New York City
Kyle, G. A.....Peking, China

Lanagan, F. R.....Albany, N. Y.
Landreth, O. H. Washington, D. C.
Landreth, W. B.,
Schenectady, N. Y.
Lang, F. A.....New York City
Langthorn, J. S....New York City
Larsson, C. G. E..New York City
Latey, H. N.....New York City
Latimer, C. A....New York City
Lavis, F.....New York City
Lawrence, R. J..Philadelphia, Pa.
Lawton, F. T.....Jamaica, N. Y.
Leavitt, C. W.....New York City
Lee, W. B.....New York City
Leffingwell, F. D..Montclair, N. J.
Lehlbach, G.....Newark, N. J.
Leighton, M. O. Washington, D. C.
Leser, H.....New York City
Lesley, R. W....Philadelphia, Pa.
Levy, J. I.....Bayonne, N. J.
Lex, W. I.....Philadelphia, Pa.
Lindenthal, G.....New York City
Lindholm, C. B...Pittsfield, Mass.

Linnell, H. P.....New York City
Lippincott, J. B..Los Angeles, Cal.
Lo, Y.....New York City
Loewe, D. L.....Cranford, N. J.
Lobo, C.....Brooklyn, N. Y.
Logan, J.....Mount Holly, N. Y.
Lohr, W. S.....Philadelphia, Pa.
Look, M. J.....Kingston, N. Y.
Loomis, H.....New York City
Loweth, C. F.....Chicago, Ill.
Lucas, E. W. V. C.New York City
Lucas, G. L.....New York City
Ludwig, J. A.....New York City
Lueder, A. B....Morristown, N. J.
Lundie, J.....New York City
Lyndon, L.....New York City

MacCornack, C. W.,
Phœnixville, Pa.
Macdonald, A. A..New York City
MacDonald, C. White Plains, N. Y.
MacFeeters, J. O. Glen Ridge, N. J.
MacGregor, R. A..New York City
Macksey, H. V....Woburn, Mass.
MacNaughton, P. J.,
Philadelphia, Pa.
Macomb, J. deN., Jr.,
Flushing, N. Y.
McCarthy, D. F..Bronxville, N. Y.
McClintock, J. R...New York City
McCollough, C. A.New York City
McComb, D. E..Washington, D. C.
McDowell, F. F....New York City
McIntyre, W. A....Ardmore, Pa.
McIntyre, W. J.Morristown, N. J.
McKean, A. M....Brooklyn, N. Y.
McLean, A.....Brooklyn, N. Y.
McLure, N. R.....Strafford, Pa.
McMillan, F. R..Philadelphia, Pa.
McMinn, T. J....New York City
McNaugher, D. W.Pittsburgh, Pa.
McNaughton, W. C.,
New York City
McNulty, G. W..New York City
McPike, M. J....Brooklyn, N. Y.
Mahoney, J. N....New York City
Manley, H., Jr..Elmhurst, N. Y.
Manley, L. B....Philadelphia, Pa.
Mansfield, W. H....Troy, N. Y.
Marshall, R. A....New York City
Martin, B. C.....Hudson, N. Y.
Marx, C. D.....Palo Alto, Cal.
Mason, F.....New York City
Masury, A. F....New York City
Matlaw, I. S.....New York City
Mattimore, H. S....Albany, N. Y.
Mead, C. A.Upper Montclair, N. J.
Meadowcroft, W..New York City
Mebus, C. F....Philadelphia, Pa.
Meeker, R. A....Plainfield, N. J.
Meem, J. C.....Brooklyn, N. Y.
Meggy, R. L. G....Fanwood, N. J.
Mehren, E. J.....New York City
Melius, L. L.....New York City
Melick, N. A.....Newark, N. J.
Merriman, M.....New York City
Merriman, T.....New York City
Metcalf, L.....Boston, Mass.
Milholland, C. V..Baltimore, Md.
Miller, A. B.....New York City
Miller, C.....Richmond, Va.
Miller, H....New London, Conn.
Miller, H. A.....Boston, Mass.
Miller, M. M.....Yonkers, N. Y.
Miller, M. S.....Brooklyn, N. Y.
Miller, R. P.....New York City
Miller, S.....New York City
Miller, S. F..South Orange, N. J.
Minor, E. E....New Haven, Conn.
Mitchell, S. P...Philadelphia, Pa.
Modjeski, Ralph...New York City
Mogensen, O. E...New York City
Molina, V.....New York City
Mönniche, T. B.....Roanoke, Va.
Moore, C. H.....New York City
Moore, E. J.....New York City
Moore, F. C.....New York City
Moore, F. F.....New York City
Moore, W. H...New Haven, Conn.

Morrill, G. P....Bridgeport, Conn.
Morrison, G.....Astoria, N. Y.
Morse, C. A....Washington, D. C.
Morssen, C. M.,
Montreal, Que., Canada
Moyer, A.....New York City
Mozart, W. J..New Haven, Conn.
Muller, G.....Brooklyn, N. Y.
Munoz, G. C...Washington, D. C.
Murphy, F. E..Washington, D. C.
Murphy, J. F.....New York City
Murphy, J. J.....New York City
Murtaugh, M. M..Allentown, Pa.
Myers, C. H.....New York City
Myers, E. T. D., Jr.Richmond, Va.
Myers, J. H...White Plains, N. Y.

Nagle, J. C..College Station, Tex.
Nelson, A. H..Atlantic City, N. J.
Nelson, F. B.....New York City
Nelson, J. W.....New York City
Newcomb, W. T.....Easton, Pa.
Noble, F. C.....New York City
Norcross, P. H.....Atlanta, Ga.
Nordell, C. H.....New York City
Norelius, L. N...Philadelphia, Pa.
Norris, W. H.....Portland, Me.
North, A. T.....New York City
Norton, A. G..Middletown, N. Y.

O'Brien, J. H....Harrisburg, Pa.
Ockert, F. W.....New York City
Odell, F. S...Port Chester, N. Y.
Ogden, J. C.....New York City
Okun, A. H.....New York City
Oleri, F. J..West New York, N. J.
O'Rourke, J. F....New York City
Ott, S. J.....Rutherford, N. J.
Owen, J.....Montclair, N. J.
Oxholm, T. S.,
West New Brighton, N. Y.

Paaswell, G.....New York City
Paine, H. A.....New York City
Palmer. G. B ..Philadelphia, Pa.
Parker, C. J.....New York City
Parker, J. L....Fayetteville, N. C.
Parlin, R. W....Fall River, Mass.
Parmelee, C. L....New York City
Parmley, W. C....New York City
Parsons, R. S.....New York City
Peabody, W. W..Providence, R. I.
Peck, J. S.....New York City
Peck, L. F.....Hartford, Conn.
Pegram, G. H.....New York City
Pellissier, G. E..Springfield, Mass.
Pendlebury, E....Arlington, N. J.
Perrine, G.....New York City
Perrot, E. G....Philadelphia, Pa.
Pett, C. E.....New York City
Pfau, J. W.....New York City
Phillips, A. E..Washington, D. C.
Phillips, A. L....Philadelphia, Pa.
Phillips, H. J.....New York City
Picken, M. W.....New York City
Pickersgill, W. C.Philadelphia, Pa.
Pierce, C. A.....Brooklyn, N. Y.
Pierce, F. E.....New York City
Pohl, C. A.....New York City
Pollock, C. D.....New York City
Pommerer, R. W. Brooklyn, N. Y.
Pond, H. B.....New York City
Pond, H. O.....New York City
Poore, H. C.East Braintree, Mass.
Porter, G. F.,
Montreal, Que., Canada
Porter, J. E.....Yonkers, N. Y.
Porter, J. M.....Easton, Pa.
Post, A. J.....New York City
Post, C. L.....Chicago, Ill.
Post, C. W.....Albany, N. Y.
Powers, C. V. V...New York City
Preston, G. H....Bloomfield, N. J.
Preston, H. W.,
Elmira Heights, N. Y.
Price, F. O.....Brooklyn, N. Y.
Price, P. L....Hempstead, N. Y.
Proctor, R. F.....Baltimore, Md.
Pugh, M. R.....Philadelphia, Pa.
Purver, G. M.....New York City

Putnam, G. R..Washington, D. C.

Quincy, E.....New York City
Quincy, R. B....New Orleans, La.
Quinn, M. F.....New York City

Randall, F. A....New York City
Rankin, E. S.....Newark, N. J.
Rapalje, de W...Plainfield, N. J.
Reeves, W. F.....New York City
Reid, H. A.....Warren, Ohio
Reimann, R.....Relay, Md.
Reimer, A. A..East Orange, N. J.
Renner, C. J.....New York City
Reppert, C. M...Philadelphia, Pa.
Reynolds, E. G., Jr.,
New Rochelle, N. Y.
Reynolds, J. O.,
Richmond Hill, N. Y.
Rhett, A. H.....New York City
Rice, G. S.....New York City
Richardson, J. D..New York City
Richardson, J. H..New York City
Richmond, J. P. W.Yonkers, N. Y.
Ricker, G. A..Washington, D. C.
Ridgway, R.....New York City
Rights, L. D.....New York City
Rindsfoos, C. S....New York City
Rinehart, C. R....New York City
Ripley, H. L.....Boston, Mass.
Ripley, J. W.....New York City
Roake, S. A.....Bloomfield, N. J.
Robbins, D. W.....Utica, N. Y.
Robbins, F. H.....New York City
Roberts, H. W....New York City
Roberts, R. F.....New York City
Roberts, W. W., Jr.,
Brooklyn, N. Y.
Rogers, E. H..West Newton, Mass.
Rohrer, J. B.....Lancaster, Pa.
Ropes, H.....Minneapolis, Minn.
Rosenberg, F.....Brooklyn, N. Y.
Rosencrans, E. J..New York City
Rossi, I.....New York City
Rowe, W. E.....Philadelphia, Pa.
Rowland, W.....New York City
Ruckes, J. J., Jr...New York City
Rugg, W. F...White Plains, N. Y.
Rumery, R. R.....New York City
Ryan, M. H.....New York City
Ryder, E. M. T....Yonkers, N. Y.

Sackett, R. L..State College, Pa.
Sacks, S. I.....Philadelphia, Pa.
Sanborn, F. B.....Boston, Mass.
Sanborn, J. F.....New York City
Sartz, J. P.....New York City
Saville, C. M....Hartford, Conn.
Sax, P. M.....Philadelphia, Pa.
Sayers, E. L.....Woodbury, N. J.
Schneeweiss, A. E..Paterson, N. J.
Schobinger, G....Hog Island, Pa.
Schuchart, P. A.. Brooklyn, N. Y.
Schurig, E. G. New Haven, Conn.
Schusler, G. W....Pittsburgh, Pa.
Schweizer, R., Jr.,
Ridgefield Park, N. J.
Schwiers, F. W., Jr.,
New York City
Scott, A. M....Charleston, W. Va.
Scott, W. V.....Flushing, N. Y.
Seaman, H. B.....New York City
Seaman, W. H..Glen Cove, N. Y.
Searle, C. D.....New York City
Seaver, C.....New York City
Serber, D. C.....New York City
Serra, J. H.....Brooklyn, N. Y.
Shaffer, I. O.....New York City
Shailer, R. A.....New York City
Shaughnessy, C. S.New York City
Shaw, F. H.....Lancaster, Pa.
Shaw, G. H.....Philadelphia, Pa.
Shellenberger, L. R.,
Bayonne, N. J.
Shelley, H. T....Philadelphia, Pa.
Shenehon, F. C.,
Minneapolis, Minn.
Sherman, H. J....Camden, N. J.
Sherrerd, M. R.....Newark, N. J.
Shertzer, T. B.....New York City

Shoemaker, L. H. .Pittsburgh, Pa.
Shoemaker, M. N. .Newark, N. J.
Sikes, Z. H. . . . . .Yonkers, N. Y.
Silliman, C. . . .Washington, D. C.
Sites, F. R. . . . . .Newark, N. J.
Skillin, E. S. . . . . .New York City
Skinner, B. B. . . .Woodbury, N. J.
Skinner, F. F. . . . . .New York City
Skinner, F. W. . . . . .New York City
Slater, W. A. . . .Philadelphia, Pa.
Sloan, S. A. . . . . .Philadelphia, Pa.
Sloan, W. G. . . . . .Nutley, N. J.
Slocum, H. S. . . . . .New York City
Small, J. H., Jr. . . .Richmond, Va.
Smith, A. . . . . .Bayonne, N. J.
Smith, C. E. . . .Washington, D. C.
Smith, E. M. . . . . .New York City
Smith, E. N. . . . . .Nutley, N. J.
Smith, E. U. . . .Philadelphia, Pa.
Smith, H. . . . .South Amboy, N. J.
Smith, H. H. . . . . .Brooklyn, N. Y.
Smith, H. S. . . .Wilkes-Barre, Pa.
Smith, J. R. . . . . .Bethlehem, Pa.
Smith, J. W. . . . . .New York City
Smith, W. F. . . .Philadelphia, Pa.
Smoley, C. K. . . . . .Scranton, Pa.
Smoyer, L. I. . . .Woodhaven, N. Y.
Snell, E. B. . . .New Haven, Conn.
Snell, T. C. B. . . .New York City
Snow, J. B. . . .Forest Hills, N. Y.
Solomon, G. R. . . . . .Atlanta, Ga.
Spencer, W. T. . . . . Boston, Mass.
Sperry, H. M. . . . . .New York City
Splitstone, C. H.,
East Orange, N. J.
Spofford, C. M. . . . . .Boston, Mass.
Sprague, E. L., Jr.,
Maplewood, N. J.
Stark, C. W. . . . . .New York City
Starr, H. H. . . . . .Philadelphia, Pa.
Stearns, E. B. . . . . .New York City
Stearns, F. P. . . . . .Boston, Mass.
Stearns, R. H. .Washington, D. C.
Stehle, F. C. . . . . .Towanda, Pa.
Stengel, C. H. . . . . .New York City
Stepath, C. U. . . . .Brooklyn, N. Y.
Stephens, A. W. .East Orange, N. J.
Stevens, E. W. .Hackensack, N. J.
Stevens, H. C. . . . . .New York City
Stevenson, W. F.,
New Rochelle, N. Y.
Stewart, S. J. .Camp Upton, N. Y.
Stilson, C. E. . . . . .Detroit, Mich.
Stone, W. W. . . . .Metuchen, N. J.
Stowe, H. C. . . . . .Brooklyn, N. Y.
Stowitts, G. P. . . . .New York City
Strachan, J. . . . . .Brooklyn, N. Y.
Strickler, G. B. .Washington, D. C.
Strobel, C. L. . . . . .Chicago, Ill.
Strong, J. B. . . . . .New York City
Strouse, W. F. . . . . .Baltimore, Md.
Stuart, J. T. . . . . .Philadelphia, Pa.
Sturdevant, J. H.,
Poughkeepsie, N. Y.
Sutton, C. W. . . . . .New York City
Swensson, O. J. .Philadelphia, Pa.
Swezey, E. C.,
Clinton Corners, N. Y.
Swindells, J. S. . . . .Brooklyn, N. Y.

Taft, J. R. . . . . .New York City
Talbot, A. N. . . . . .Urbana, Ill.
Talbot, E. . . . . .Englewood, N. J.
Tallman, L. . . . . .Brooklyn, N. Y.
Taussig, J. W. . . . . .New York City
Taylor, C. F. . . . . .New York City
Taylor, G. B. .New Britain, Conn.
Taylor, W. G. . . . . .Newark, N. J.
Terry, A. H. . . . .Bridgeport, Conn.
Thomes, E. H. . . . .Jamaica, N. Y.
Thompson, S. C. . .New York City
Thompson, S. E. . . . .Boston, Mass.
Thompson, W. G. B. Trenton, N. J.
Thomson, T. K. . . . .New York City
Thorn, H. B. . . . . .New York City
Tidd, A. W. .White Plains, N. Y.
Tighe, J. L. . . . . .Holyoke, Mass.
Tilden, C. J. . . . . .Baltimore, Md.
Tomkins, C. . . . . .New York City
Tomlinson, C. P. .Hartford, Conn.

Tompkins, C. H. Washington, D. C.
Tooker, F. W. East Orange, N. J.
Torrey, J. E. Paterson, N. J.
Tower, J. W. New York City
Townsend, F. T. New York City
Townsend, T. M.,
Schenectady, N. Y.
Tozzer, A. C. New York City
Tresise, F. J. Buffalo, N. Y.
Tretter, G. A. Roanoke, Va.
Tribus, L. L. New York City
Triest, W. G. New York City
Trimpi, A. L. East Orange, N. J.
Trout, C. E.,
West New Brighton, N. Y.
Trow, F. H. Kingston, N. Y.
Tull, R. W. New York City
Tuska, G. R. Washington, D. C.
Tuttle, A. S. New York City

Uhl, W. F. Boston, Mass.
Underwood, H. W.,
Philadelphia, Pa.
Ungrich, M. J. New York City
Upton, J. Flushing, N. Y.

Vail, E. M. Plainfield, N. J.
Vail, J. J. Rahway, N. J.
Van Alstyne, H. A. New York City
Van Cleve, A. H. Buffalo, N. Y.
Van Horne, J. G. New York City
Van Norden, E. M. New York City
Vincent, J. I. New York City
Vogel, J. L. Jersey City, N. J.
Vogleson, J. A. Philadelphia, Pa.
Voynow, C. B. Philadelphia, Pa.

Wadsworth, J. E. New York City
Wagner, H. E. Brooklyn, N. Y.
Wagner, S. T. Philadelphia, Pa.
Wahlman, P. New York City
Wait, B. H. New York City
Waite, D. C. Brooklyn, N. Y.
Waite, G. B. New York City
Waldron, S. P. Boston, Mass.
Walker, C. I. New York City
Walker, I. S. New York City
Walker, J. J. Dobbs Ferry, N. Y.
Wall, E. E. St. Louis, Mo.
Wallace, J. F. New York City
Ward, E. A. Newark, N. J.
Wasser, T. J. Jersey City, N. J.
Waters, W. L. New York City
Watson, C. H.,
Great Neck Station, N. Y.
Watson, M. New York City
Watson, R. M. Rutherford, N. J.
Watters, G. L. Bethlehem, Pa.
Webb, D. J. H. New Haven, Conn.
Webster, A. L. New York City
Webster, G. S. Philadelphia, Pa.
Weed, L. W. Philadelphia, Pa.
Wegmann, E. Yonkers, N. Y.
Weitzner, H. M. New York City
Weldin, W. A. Pittsburgh, Pa.
Welty, H. T. New York City
Wendt, E. F. Washington, D. C.
Weymouth, A. New York City
Wheeler, R. C. Newport News, Va.
Whinery, S. New York City
Whitcraft, L. N. Hackensack, N. J.
White, B. E. Utica, N. Y.
White, L. New York City
White, T. S. Beaver Falls, Pa.
White, W. M. New York City
Whited, W. Harrisburg, Pa.
Whitney, A. R. New York City
Whitney, G. C. Brooklyn, N. Y.
Whitson, A. U. Flushing, N. Y.
Wickham, H. R. Brooklyn, N. Y.
Widdicombe, S. H. New York City
Wiggin, E. W. New Haven, Conn.
Wigley, C. G. New York City
Wilcock, F. Brooklyn, N. Y.
Wiley, W. H. New York City
Wilkerson, T. J. Beaver Falls, Pa.
Wilkes, J. Nashville, Tenn.
Wilkins, W. G. Pittsburgh, Pa.

Williams, C. G....Plainfield, N. J.
Williams, F. P.....Albany, N. Y.
Williams, G. S..Ann Arbor, Mich.
Williams, J. P. J..New York City
Williams, M. W...New York City
Willoughby, J. E.,
Wilmington, N. C.
Wilmot, S.....Providence, R. I.
Wilson, C. W. S.,
New Rochelle, N. Y.
Wilson, W. T.....New York City
Wilson, W. W.....Bridgeport, Pa.
Winsor, F. E....Providence, R. I.
Winsor, G. A..Pleasantville, N. Y.
Winsor, H. D.....New York City
Wise, C. R.....Passaic, N. J.
Wise, R. S.....Passaic, N. J.
Witmer, F. P.....Brooklyn, N. Y.
Wolfel, P. L.....Pittsburgh, Pa.
Wolff, A. D., Jr....Hudson, N. Y.
Wolff, H. H.....Denver, Colo.
Wolff, R. B.....New York City
Wood, G. P.....Peekskill, N. Y.
Woodcock, H. W...Brooklyn, N. Y.
Wright, F. H.....Brooklyn, N. Y.
Wyckoff, C. R....Hartsdale, N. Y.
Wyman, A. M....Philadelphia, Pa.

Yates, E. A...Perth Amboy, N. J.
Yates, J. J.....New York City
Yates, P. K.....New York City
Yates, S. S.....Englewood, N. J.
Yates, W. H.....New York City
Yereance, W. B....New York City
Young, C. G.....New York City
Young, H. A.....New York City

Zeltner, E. L....Elmhurst, N. Y.

# GOVERNMENT WAR CONSTRUCTION WORK IN THE UNITED STATES

An Address by Brig.-Gen. R. C. Marshall, Jr.,
Chief of Construction Division, U. S. A.,
at the Annual Meeting, January 15th, 1919.

Permit me to assure you, in beginning, of my sincere appreciation of the compliment which has been extended to me by the American Society of Civil Engineers in the invitation to address its members gathered here at this meeting. It is probable that this is the most important meeting of the Society which has ever been held. Engineering problems encountered and overcome within the past year of unprecedented activity—unprecedented both in volume of work and in conditions under which it had to be accomplished—and problems which will face this Society, as well as every other constructive organization of Americans, involving the renewed activities of peace and commerce, are matters for its most sober and intelligent consideration. I feel that I may properly talk to you as a brother in interest by reason of the fact that the Construction Division numbers in its membership so many members of the American Society of Civil Engineers, and I have been necessarily intimately in contact with them and with the many problems that they have had.

Of the detailed technical side of these matters I cannot hope to be of informative value to this audience, and I have no ambition to attempt the "transportation of coals to Newcastle." The work of construction for the War Department, carried on during the period of the war by the Construction Division of the Army, with which I have been intimately associated, and the experience which has been mine during the time of its accomplishment will, however, I am constrained to believe, be of some value, at least, in opening a field for thought and for subsequent action.

Briefly outlining what the Construction Division is, and what it has done, it may be stated that it is a Bureau of the War Department charged with the entire construction work of and for the Army, in this country, in the Hawaiian Islands, the Philippine Islands, Alaska, Porto Rico, and the Canal Zone. It has done all this construction work, including the camps for the accommodation of the first increments of the tremendous Army called into being under the Selective Service Act and the federalization of the National Guard.

The magnitude of the undertaking cannot be over-emphasized when it is considered that the sites for these camps were not selected until the period from June 6th to June 17th, and it was proposed to call the first contingent of conscripted men to camp during the first week of

September. Hence, there remained only about 90 days in which to complete the plans in Washington for general arrangements, prepare specifications and contracts, select the contractors, organize field forces for the contractor, Constructing Quartermaster, Supervising Engineer, and Auditing Division, as well as to build at each of sixteen sites a cantonment estimated to cost, roughly, $6 000 000, to house about 40 000 people and about 10 000 animals.

In a little more than 3 months the Cantonment Division was expected to have suitable quarters ready for the training of more than 1 000 000 men. In the construction of the camps, it was proposed to build, in an entirely undeveloped tract of land, a site capable of housing, on an average, 40 000 persons. This site was to be complete, with housing, railroad tracks, roads, and all the various utilities. A group of engineering problems of first importance had to be solved: the water supply for each camp studied; proper sewerage provided; heating, lighting, refrigerating, and laundry facilities furnished. The solution of these engineering problems was different in every locality. The planning alone, for construction work of each of the camps, would normally take as many weeks as was given for the completion of both the engineering and the building. It was necessary that the planning, engineering, and building go forward together.

In each camp, the building, aside from the engineering problems, was a huge operation. Each cantonment required millions of feet of lumber; and several thousand carloads of construction freight had to be handled in each yard. Many of the cantonments and camps were at places served by one track only. Extra railroad facilities had to be provided for handling the materials necessary for the construction of the camps. Labor had to be imported from a distance, in many instances, as many of the cantonments and camps were at points remote from labor markets. The problem of organizing the men into efficient construction forces was very great.

The prevention of the epidemics and diseases incident to the housing of troops is dependent on the engineering skill of design and its subsequent execution. In the cantonments and camps in this country the exact proof that these were of the highest order is that there has not been a single epidemic or, indeed, so far as is directly traceable, a single case of water-borne disease or disease due to insanitation. As a further illustration of this, I quote from *Engineering News-Record* of August 29th, 1918:

"Combined reports for the American armies at home and abroad showed a death rate from disease of 1.9 per 1 000 per annum for the week ended July 26, based on a total of 2 500 000 men. For the past two months the rate was 2.8. The rate for men of military age in civil life is 6.7. Records for earlier wars, according to the office of the Surgeon General, were: Mexican, 100; Civil, 40 in 1862 and 60 in

1863; Spanish-American, 25; Russo-Japanese (for Japanese troops), 20. (It should be noted that the civil rate and the earlier war rates are for long periods.)"

In addition, the Division has constructed, speaking generally, arsenals, wharves, docks, and forts, tremendous port terminals, reserve storage warehouses, hospitals of all sizes and descriptions, aviation fields, proving grounds, embarkation camps, engineer camps, gunnery schools, powder plants, factories, and additions to manufacturing plants, and plants for the construction of munitions, including special new plants for the manufacture of acids, gases, nitrates, phosphorus, T.N.T., and other explosives, with incidental work in the nature of housing and lighterage construction connected with the above. The magnitude of the task involved is indicated by the fact that during the past 16 months the cost of the work on which the Construction Division has been engaged has exceeded $800 000 000—$50 000 000 per month—and has involved more than 500 jobs scattered all over this country, in fact, in every State but one.

If the average American were asked to name the greatest engineering and construction feat of this age, he would most certainly mention the Panama Canal. In the construction of this canal the expenditures never exceeded $50 000 000 a year, and the total cost was approximately $375 000 000, covering a period of 10 years. The entire work, in its greatest length, from end to end, was 50 miles.

From a construction programme as gigantic and as diversified as the Army building activities, in the past year and a half, it is inevitable that thoughtful men may draw many lessons in many fields: the high pressure under which the work had to be done, the urgent and absolute necessity for almost frantic speed in the completion of every project, and the consequent differences in the manner of procedure, have demonstrated that many things hitherto thought impossible are on the contrary highly advisable, and many things hitherto universally accepted almost as axioms are neither true nor to the interest of efficiency or economy.

Let me advert to the form of contract which the Construction Division has used. Popularly, it is almost universally known as a "Cost-Plus Contract", but, strictly speaking, this term is not exact. The contract which has been used from the beginning, with slight modifications in non-essential details, has been one in which the contractor was reimbursed his actual expenditures with a fee to him graduated on a sliding scale. The percentage he receives gets lower as the cost increases, and a maximum figure is set which his fee can, in no case, exceed, no matter what the cost of the work may be. Many reasons dictated the adoption of this form of contract which, to all who understand the facts, has proved its usefulness and its value beyond the peradventure of a doubt.

Take for a moment's consideration the conditions under which the original camps were built. The Cantonment Division (which later was enlarged and developed into the present Construction Division) was told that in 90 days it must complete the following work: It must have quarters ready for the training of more than 1 000 000 men; it must go upon thirty-two virgin sites and on each one build a camp, equipped in all essential details, to house and accommodate a draft army about to be called to the colors. It must draw, co-ordinate, and complete the plans, prepare specifications and contracts, select the contractors, organize field forces for them, appoint Constructing Quartermasters, Supervising Engineers, and attending organizations. It must see that material in immense quantities was forthcoming; it must foresee and solve the engineering problems involved, and it must build sixteen cantonments, roughly estimated to cost $6 000 000, each to house 40 000 people, and sixteen tent camps, at about half the cost of the cantonments, but to accommodate almost as many men. Rough building was not sufficient—roads must be laid out, water supply and sewerage problems developed and overcome, and the result must be, so far as public utilities are concerned, comparable, at least in efficient working ability, with those of a city of the same size; and all this in 90 days.

Could any other contract known to man, or which the ingenuity of man could devise, have taken care of this situation? The making of plans, the advising of engineering features, the procurement of material, the formation of the organization, and the building itself had all to go hand in hand. The markets for material and labor were in a period of instability, to an extraordinary degree, and no contractor on earth could have made an intelligent bid on any one of these projects, had he had plans and specifications on which to base it. Nor, conversely, could plans and specifications have been furnished him, had he been in a position to bid.

Let me not be misunderstood, the sole justification for the cost-plus contract, as used during the war, is not the uncertain and unstable condition brought about by the war, for the cost-plus contract, properly administered, is the proper, conservative, and just method of doing contracting work—just, alike to the owner, the engineer, and the contractor. In this connection I want to draw the attention of this audience to the trend of Congress in this matter, as indicated in two provisions of law. In the "Bill making appropriations for the support of the Army for the fiscal year ending June 30th, 1919," Public No. 193, 65th Congress, the following appears:

"Provided, That where practical so to do no work be done or contract made under or by authority of any provision of this Act on or under a percentage or cost-plus percentage basis, nor shall any contract, where circumstances so permit, be let involving more than $1 000

until at least three responsible competing contractors shall have been notified and considered in connection with such contract and all contracts to be awarded to the lowest responsible bidder, the Government reserving the right to reject any and all bids".

Also, "An Act to Authorize the President to provide housing for war needs," Public No. 149, 65th Congress, Section 7, reads as follows:

"That no work to be done or contract to be made under or by authority of any provision of this Act shall be done or made on or under a percentage or cost-plus percentage basis, nor shall any contract be let until at least three responsible competing contractors shall have been notified and considered in connection with such contract, and all contracts to be awarded to the lowest responsible bidder, the Government reserving the right to reject any and all bids".

I cannot believe that this tendency of Congress has been brought about through any effort by this Society, or any similar to it. I am convinced that the best thoughts are quite to the contrary. I do believe that these laws, and similar talk in Congress, is brought about by the lack of effort on the part of this Society and similar ones.

Education, of course, is the only remedy worthy the name for ignorance or for mistaken apprehension of facts. Through ignorance and through mistaken apprehension of the facts of the case, the emergency contract outlined above has been the subject of bitter attack from persons in and out of the Government service and from quarters high and low. Let me add that, in my opinion, these attacks, in most cases, have been sincere, but due entirely to a mistaken apprehension of the nature of the causation of the actual operations and of the results of these contracts. They have saved—and this is demonstrable—to the Government a vast sum of money. They have operated with smoothness and flexibility, and with surprisingly little misunderstanding or friction between the Government and the many contractors in question. Without them the vast building programme of the Army, which has been successfully accomplished, would have been a matter of utter impossibility.

However, from the very fact that they have not been understood, that their nature is not clearly seen, and that the people in general, including National legislators, have not informed themselves concerning them, they are in bad odor in many quarters, and a more or less determined effort is being made to prohibit their further use. I trust it will not be presumptuous in me to say that I am satisfied that the remedy for this state of affairs is the education of Congress and of others who oppose this or other measures because they do not understand them, and this education should not come through the education of the people at large, and the consequent infiltration of the knowledge thus disseminated into the legislative brain; the process should be reversed. The men who make the Nation's laws should themselves

be informed of the truth, and, in matters such as this, it is the province of just such Societies as yours to act as the educational agency.

I say of Societies such as yours, because, to my mind, the future of the contracting industry and of the engineering societies is indissolubly linked together. The contractor cannot function without the engineer. The engineer cannot function without the contractor, and I use the term engineer in its broadest sense. The work of the Construction Division has demonstrated that the closest co-operation and co-ordination is an absolute prerequisite to successful accomplishment which has been attained under the most trying and disheartening conditions. Without that co-operation nothing could have been done.

This brings me to another thought which I wish to urge for earnest consideration by this audience. It is my belief that the dignity, the power, the learning, and the history of accomplishment of the engineers of this country make them a factor in its future undertakings which must in time be realized and accepted by the Government. They should be gratefully and heartily accepted by the Government as a constructive force and as an instrument of accomplishment which, properly taken advantage of, will be second to none; but, in order that the fullest good can come from such a consummation, there must be the utmost harmony, the utmost flexibility, and the most thorough co-operation among the engineers themselves.

Let me illustrate: In the building operations of the Construction Division, there has never been a time when the great engineering societies of this country have not been willing and eager to lend their assistance to the work of the Construction Division, each and every one of them, and I wish here and now to tender publicly my grateful and heartfelt thanks for this invaluable assistance extended so generously and so freely; but, in every case, the War Department had to treat with a number of more or less isolated societies, *e. g.*, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and so forth. There are nineteen of them, I am told.

In union there is strength, and there is no axiom, of the many which are so freely mouthed, which is so true and so universal in its application as this one. Had there been amalgamation of these societies, a consolidation if you will, a central governing body to which they were all subsidiary, or in some shape or form a co-ordination, a central direction, some one head to which they all looked and with which an outside agency could treat, the task of the War Department would have been infinitely simplified. I believe that, for the greatest good of the engineers, of the Government, and of the economic life of this country, some such arrangement will have to be made. Concerning the form or the method, I do not know and would not presume to advise. Concerning the wisdom of such action, I am as sure as I am

of anything in the world, and I urge it upon you to consider it and to make it an accomplished fact as soon as may be.

The experience of this work has shown the infinite wisdom of a close rapport between governmental agencies and the large commercial and professional organizations whose aid must be enlisted at any time of National crisis. Such aid has been freely given during this war, but the method of effecting its greatest accomplishment has been hindered and hampered by the fact that, at first, the parties had to establish mutual understandings, to get each other's viewpoints, and to adjust themselves to a changed and unfamiliar method of accomplishing results. There should be in the future—there must be—close touch and sympathy between such organizations and the executive departments of the Government.

This, I hope, will be particularly the case with the membership of the Engineering Societies of America. Just what form legislation will take concerning military training and the formation of a reserve army, no man can at this moment say. It is inconceivable, however, to any thinking man that our state of National preparedness and our ability to take advantage of all existing agencies of protection, and to mobilize our men and resources for national defense, will ever again recede to the condition they were in when the present conflict was forced upon us. Some sort of reserve army is inevitable.

The tremendous construction undertakings of the Government, the facilities for arming, equipping, training, and supply of our soldiers will have to be kept up, at least in some measure. Building operations may be continued in some shape or form. In any event, and in whatever shape the ultimate result may be reached, the opportunity for the membership of the engineering societies to serve actively in the Government and to make both themselves and the powerful organizations which they represent of the greatest value to the nation is clear.

Without the membership of your Society embraced in the Reserve Corps, in the National Army, the men who threw aside all thought in themselves, their ambitions, and their undertakings, to offer the resources of their bodies and brains to their country, the results which were attained would have been impossible. Had these men in the beginning been trained to think along not only professional but military lines the results would have been even more astounding in their success.

Let me urge upon you men, whose services are of such an inestimable value and who have the urge of patriotism in your hearts, enroll yourselves in whatever reserve may be contemplated. By such a course of action and by intelligent interest in the army on the part of the individuals involved, two results should be attained. The liaison between the engineering societies and the Government should be

strengthened, and a reserve of trained and most invaluable soldiers will be at hand at any time of National emergency.

I have, as I promised in beginning, said little about the technical features of the work involved in the construction undertakings of the War Department. The technical journals have portrayed and will portray them at length and in detail, both as matters of general interest to the profession, and some few of controversial interest which, by process of discussion, investigation, and experimentation, must inevitably result in great strides in accomplishment. In the diversified construction operations in which the Construction Division has been engaged, these problems have been faced in myriad forms. They have been solved in many ways.

The question of sewage disposal—one of the most vital and important which faces the municipal governments of this country—has been treated in a manner rather radically different from what obtained before the war. The use of wood-stave pipe in large water supply projects was adopted in the beginning as a necessity, from inability to obtain the necessary metal pipe, and has been developed and perfected. The work on the tremendous interior storage depots and the great terminals and ports of embarkation, involving construction of the most permanent character, has brought forward many most interesting situations. The conditions of the work, and the necessity for continuing in all weathers and in all seasons, have produced in many instances new methods of going about the work and new records of accomplishment.

With these matters, I am sure, this audience is already thoroughly familiar, and in a talk such as this, I feel, is not the time or the occasion to amplify them in detail. I have, however, brought with me some lantern slides to attempt to give some conception of the magnitude and the character of the work in which I and so many others have been engaged, and these will incidentally contain, I hope, some points of interest from a professional standpoint.

(Gen. Marshall showed a number of lantern slides illustrating the work of the Government in the United States during the war.)

In conclusion, I desire to thank you again for this opportunity and for the attention which you have given to my remarks. I have endeavored only to convey to you the facts which my experience of the past eighteen months has impressed upon my mind and heart, and to indicate what I believe to be courses which should be pursued, and which, in my opinion, will be far-reaching and of tremendous importance in their beneficial results. You realize, of course, that I am speaking to you not as an engineer, but as a soldier; but if, by reason of the duties to which I have been assigned, my experience will ever be of benefit, or my advice can ever be thought of importance, I offer it as freely and as heartily as the offers which have been made by your Society and so gratefully accepted by the War Department.

## ITEMS OF INTEREST

### Informal Addresses by the Delegates of the Four Founder Societies to the Joint Engineering Congress, held in Paris in December, 1918.

**February 10th, 1919.**—A Joint Meeting of the Four Founder Societies, called for the purpose of hearing informal addresses by their delegates to the Joint Engineering Congress in Paris, was called to order at 8.30 P. M.; Col. Herbert S. Crocker, Vice-President, Am. Soc. C. E., in the chair; T. J. McMinn, M. Am. Soc. C. E., acting as Secretary; and present, also, about 500 members and guests.

The following statement, prepared by the Secretary, was read:

In October last, Maj. J. F. Case, M. Am. Soc. C. E.—who not long before that had returned from France—reported verbally that the French Engineers were extremely desirous of having a Delegation of American Engineers present at the Engineering Congress to be held in December, 1918, and subsequently the matter was brought to the attention of the Executive Committee of the Board of Direction of the American Society of Civil Engineers. After an exchange of cables, this Society accepted the invitation of the French Engineers, which was forwarded with the approval of the French Ministries of Public Works, of Commerce, and of Armament, to form a delegation of engineers to attend a Joint Engineering Congress for formulating plans for the restoration and development of French industry, with the co-operation of the other three Founder Societies.

Inasmuch as the Congress was to be held about the middle of December, there was necessity for great haste. Engineers had to be selected whose specialties covered points in reconstruction and development work which the Congress had especially laid down for discussion. At the same time it was necessary that these engineers should be prepared to sail almost immediately.

The difficulty of securing passports, for which personal application must be made, and of securing accommodations for the voyage, all tended to make it necessary to act very promptly. The other three Societies were communicated with, with the result that E. Gybbon Spilsbury was appointed to represent the American Institute of Mining Engineers, President Charles T. Main of the American Society of Mechanical Engineers was appointed to represent that Society, and Lewis B. Stillwell was appointed as the representative of the American Institute of Electrical Engineers.

The subjects to be considered by the Congress were largely in the line of Civil Engineering work, and the representatives of the Civil Engineers selected were: Maj. J. F. Case, who was selected as Chairman of the Delegation, George W. Fuller, A. M. Hunt, Nelson P. Lewis, George F. Swain, and George W. Tillson.

Accommodations for the voyage were reserved even before the Delegation was appointed, and, after numerous difficulties, among which might be mentioned the fact that the application for passports was refused at first by the State Department, the Delegation sailed for

France on December 5th, 1918. Since that time no official word has been received from the Delegation, and this meeting has been arranged to hear from them in a more or less informal manner what they saw and what they accomplished, pending the receipt of a formal report of their activities, which will be presented to the four Societies which the Delegation represents.

I think it might be well to state that although there has been no fault found with the action in accepting the invitation of the French Engineers, and no objection to the personnel of the Delegation chosen has been made, there has been the criticism that the choice was confined to engineers living in New York and Boston. It is apparent, however, that it would have been impossible to consult with qualified engineers living at a long distance from this port, and to have succeeded in making up a satisfactory Delegation on the basis of geographical distribution within the time at the disposal of the governing bodies of the Societies.

The Chairman.—I shall waste no time in elaborate introduction of the speakers, because they do not require it. Maj. Case is still in France; Mr. Main is unable to be with us to-night on account of an important engagement in Boston. We will first hear from Dr. George F. Swain, who will speak on Technical Education and Waterways.

George F. Swain, Past-President, Am. Soc. C. E.—Mr. President and members of the Engineering Societies, I shall not confine myself wholly to those topics which the Presiding Officer has mentioned. Probably the only reason for asking me to speak first is that I happen at the present time to be the Chairman of the delegation, as Maj. Case did not come back with us.

In March, 1918, there was held a Congress of engineers in France, and this Congress is still in existence. It was gotten up and carried on by business men, manufacturers, public men, and engineers, to deal with problems of engineering. The Chairman was M. Millerand, who was Minister of War at the beginning of the war. One meeting of the Congress was presided over by M. Clementel, Minister of Commerce.

They wanted to consult with American engineers on engineering problems of reconstruction. This does not mean the building up of the destroyed districts. Reconstruction has three stages in France: first, the conversion of industries from a war to a peace basis; the changing over of the factories that have been making shells, so that they can make automobiles or some other product.

Then, second, would come the rebuilding of the devastated districts; and, third, would come the great engineering problems which face France. It was with the last of these problems that this commission had to do. We had nothing to do with the actual changing over of industries or with building up the devastated regions, but were consulted with reference to the larger problems.

This Congress was divided into committees, and the committees were on ports, navigable waterways, roads, agriculture, rural sanitation

and hygiene, water power, and technical education. Those are all great problems which confront France.

We had the privilege of spending a month in France. We arrived on December 16th, and sailed on January 18th. We went straight to Paris, and there had meetings with the various committees of the Congress; we met the Chairmen and the engineers connected with those committees, and discussed the problems with them. They asked us questions; we answered them if we could. We have still several reports to prepare and send back to them.

We were treated with the greatest kindness and courtesy, in every possible way. They arranged excursions for us. They took us first to Nantes and St. Nazaire, where we spent two days. We saw what the American engineers had done, and what the French had done.

Later, we went to Southern France, going first to Grenoble, in the region of the Alps, where there are very great water powers, many of them developed, many more undeveloped. From Grenoble we went to Marseilles, and saw the port works there, the great tunnels and canals, that the French are building.

Coming back we spent two days at Lyons; we visited their industries, some water-power works, and so forth; and then back to Paris, where we had some further meetings of the Congress and the Committees.

Coming home we spent two days at Bordeaux where we saw the port works. We were entertained most hospitably wherever we went. We were entertained by Chambers of Commerce at Nantes, St. Nazaire, Bordeaux, Grenoble, Marseilles, and Lyons. We had the privilege of meeting a number of the ministers of the cabinet in France. We met M. Clementel, M. Loucheur, Minister of Reconstruction, and M. Pichon, Minister of Agriculture. We were received by Marshal Joffre, and met many of the other leading men of France.

The railroad companies treated us in a manner very surprising. When we went to Nantes and St. Nazaire, we had a private sleeping car, which waited there and brought us back. When we went to Lyons, a private car was placed at our disposal for a week. It was the same at Grenoble; the car waited for us and brought us back to Lyons and then to Paris.

I assure you, gentlemen, that traveling in France is not either pleasant or comfortable at present, if you have to travel in the ordinary way, as anybody who has been there can testify. With our private car we were very comfortable; and our thanks have been duly acknowledged to the railway companies, and to all the other parties who contributed to our pleasure and the profit of our trip. We think that something has been accomplished.

The French engineers are very anxious to co-operate with American engineers. They want to get American capital for France, and to learn American methods of work. They are very much surprised,

I think, by the work that American engineers have done there; and they think that possibly by co-operating in the future, both countries will be benefited. I thoroughly believe that such is the case.

At the last meeting of the Congress, M. Millerand was very earnest in urging that a permanent Franco-American International Committee should be appointed. We should keep in touch with each other, and by this means French engineers could inquire of American engineers and American engineers could inquire of French engineers, and get information. The Congress voted at its last meeting in favor of the appointment of such a committee, and appointed as the French members the Chairmen of all the various committees with whom we had been dealing—the very men with whom we had been in contact for a month in France.

They asked us to serve as the American members of the permanent committee; but we very properly declined, saying that we were simply appointed as delegates by our four National Engineering Societies, and that all we could do was to come home and report, and we have submitted a report to them stating these facts.

Before leaving France we presented a preliminary report to the French engineers. This report answered questions they had asked, and expressed our views on the various resolutions which had been passed at the first meeting of the Congress in March last, all of which we had in our possession before we left here.

We are now preparing a report, which will be submitted to the four National Engineering Societies, describing our work in detail.

France has done more than any other country in Europe toward developing a system of internal waterways. It has spent about $360 000 000. All the works are owned and maintained by the Government. It has assumed the debt, pays the interest thereon, and maintains the works.

Any man may buy and operate a boat on a canal. When one pays for canal transportation, one simply pays the boatman his charge, but does not pay any interest on the first cost or any cost of maintenance. Manifestly, under those circumstances, you cannot compare properly the rates for water and rail transportation, because the railroads are in a very different situation.

The railroads are dominated by the Government and one of the seven railroad systems of France is actually owned by the State.

Now, the French have great plans for internal navigation. They must develop their ports, if they are going to take care of the traffic which formerly went to North Sea ports, to Bremen and Hamburg, and which they hope will hereafter go through France. The French have been planning very great works of improvement for their ports, but, of course, they have to provide the transportation inland from them, and that can be either by rail or by waterway.

They seem to have a great idea of developing waterways. That was the only point, I think, in which the members of the delegation were not—and certainly I myself was not quite—in sympathy with the French engineers. We saw plans for spending large sums of money in building canals and making rivers navigable, but we saw not one study of the economies of any of those questions; no statistics of transportation, no study as to whether they could get any return on the expenditure.

They have, for instance, a scheme for spending $200 000 000 for making the Rhône navigable up to Lake Geneva. Probably they could build a double-track railroad up there for less than would be required to make the Rhône navigable, and it would probably carry the traffic at much less expense.

We were surprised that, in the proceedings of the Congress, so little study was given to the subject of railroads, although they are undoubtedly the most important agency in the development of national prosperity.

The question of internal navigation by canals and navigable rivers above the ports will be discussed in detail in our formal report. The projects are very interesting, but in the present emergency it seems to me that we must regard the economic aspect of State expenditures more than ever before. All the nations of the world are poor. They have been spending immense sums of money for war purposes, and there has been an immense destruction of property. There has never been a time in the history of the world when it has been more desirable to go slowly and to scrutinize every expenditure, whether public or private, to see that sound economy is practiced.

One of our committees had to deal with technical education. Such education in France appears to have been very theoretical.

I think the French realize that, with them as with us, the events of the last few years ought to lead to changes in educational methods. One great thing is to have one nation learn from another; and the best time to learn is when a man is young. We emphasized at every opportunity the desirability of having Americans go to France to study and Frenchmen come to America to study.

Few people realize how many of the most eminent men in this country, especially men of science, have studied in Germany. I do not think that is going to be so in the future. I hope not.

Still, it is a great thing for a young man to go abroad. There is a great broadening influence in spending a few years in a foreign country, not only for the language, but for the generally broadening influence on a man's character, learning other people's methods and points of view, learning what they have to teach; and I hope a great many young Americans who want to go abroad to study will go to France.

In the past, however, France has not encouraged that. When I was a young man I wanted to go to France, and I tried to do so, but I was not encouraged at all by the French authorities. On the other hand, I could go to Germany, and could get admission to the German polytechnic school, without the slightest trouble, and they would be glad to have me, and I went.

We told the French they would have to change their point of view in that respect; they admitted that they would have to, and said they wanted to.

A man may go to a foreign country to study with some particular professor, and France certainly has most eminent men in every line. The equipment of their schools, however, as far as we observed, does not compare with what we can offer in some of our schools.

Their engineering schools are in the hearts of the cities, where they cannot grow; where they have no room for laboratories or any expansion. One of the ministers said they were going to appropriate large sums for technical education. I hope they will open their schools to foreign students without undue restriction, and that there will be in the future an interchange of our young men with their young men.

The Chairman.—The second speaker is Mr. George W. Tillson, who will speak on the subject of Roads.

G. W. Tillson, M. Am. Soc. C. E.—Mr. Chairman and Gentlemen: The French gave us certain subjects which they wished us to consider. One subject was "Roads," to which Mr. Lewis and myself were specially assigned.

I was considerably surprised at this, because I knew that the French, for many years, had had the reputation, and justly too, of having the best system of roads, probably, in the world, when you consider the whole country.

Our method of procedure over there, in general, was that our committees should meet with their committees on the same subject; and our Committee on Roads met the Committee on Roads of the Congress, which was headed by M. Heude, formerly Inspector General of the "Ponts et Chaussées". The French understood from the severe traffic during the war that their old roads would not stand up under that which was to come, and also that, owing to the lack of attention given them during the war, there was a great deal of work to be done at this time.

As an instance of what has taken place in belligerent countries, I may say that the English Road Board has issued a statement that it is necessary now to expend about $50 000 000, to put the important roads of Great Britain in the condition that they were in before the war.

The French realize, too, that motor traffic received a great impetus during the war, and they want to build roads that will stand such traffic as it will further develop. You know that the French, perhaps more

so than other people in Europe, build with the idea of permanence. They do not build as cheaply as we do. They have studied the work that has been done in other countries, particularly in road construction, and especially during the war period, to see what has been done by us. Their information has come principally from reports of road congresses, and what personal, individual information they have been able to obtain.

They are satisfied that the old method is going; they cannot use it any longer; and they presented us with a written summary of their views. They had come to the conclusion that the sprinkling, oiling, or tarring of roads was only a temporary expedient. Of course, we agreed with them in that. The types of road construction that seemed to appeal to them most were asphalt macadam by the penetration and mixing methods.

They were pretty well conversant with these types of construction, and they felt that the penetration method was the better for them, because it was cheaper than the mixing method, owing to the cost of the plant required for the latter.

The views of the French members of the Road Committee appeared to confirm the impression of Professor Swain, as to the lack of study of economic questions in these matters. They seemed to consider first cost more than ultimate cost, and because the mixing method cost more, seemed to dismiss that almost entirely from consideration.

The members of our committee urged the consideration of other types of roads, such as concrete and brick. We told them of the concrete roads which had been built in America during the past 10 years, and the good results that had been obtained, and that they could expect good results in France because their climate is more favorable, without the extremes of temperature which we have, and which cause cracks in the concrete.

We knew that in France they had large cement works and that they should be able to construct cement roads at reasonable cost. They told us that they had good stone for road construction, of whatever character they needed.

It seems that some years ago they had built in one part of France a concrete road which had not been a success, and for that reason they seemed to think it needed no further experiment. We told them that the first concrete roads in this country were not completely successful, but that they had improved very much as a result of experience in methods and with materials. They agreed in the final conclusions to recommend the use of cement concrete, where the materials were so convenient that it would be cheap.

As a matter of fact, we afterward saw in Grenoble quite a lot of cement concrete pavement that looked as if it had been down some years, and was in good condition.

As to brick, they dismissed that in their preliminary report, because they said that France was not a brick country. Although that is true of Southern France and the vicinity of Paris, where stone is used for buildings, bridges, and nearly all kinds of construction, when we went north, we found that brick was used almost exclusively, especially at Arras and Lens and in that section. Whether there are clays and shales that would make a good paving brick, of course, we do not know; but we told them that we thought it would pay them to experiment and find out if they could not produce paving brick which would prove as satisfactory as have those in this country.

We told them of the indifferent success first achieved here and of the subsequent improvement, until brick is now one of our standard paving materials. They finally joined in the conclusions to that effect.

Then came up the question of finance; not only how should the money be raised, but how it should be paid to the contractor; both of which questions were of considerable importance to them.

We described to them the method of special assessment so frequently used in America. The idea seemed to appeal to them, but they thought that under present conditions in France, and under existing laws, it would be hardly possible to adopt it, but that the better way to finance their road work was by state, departmental, and communal appropriations.

They asked us specifically, "Will American contractors come over here and do road work, and take their pay in 15 annual installments?" We told them, "Yes, but you must understand this: First, they must have absolute and positive arrangements made for the payments, as to which there must be no question; and, secondly, if you pay them in that way, you will pay 60 or 75% more for the work than you would if you paid when it was completed."

That did not seem to appeal to them. We pointed out that if they were to issue serial bonds, say for 15 years, and pay the contractor in full when the work was done, the interest and principal sum would be much less.

As an abstract proposition, that seemed to appeal to them. As a concrete proposition, they came back to the condition that that is not the way they do it in France; and the French are very conservative. When we suggested that if it were against the law they might change the law and so carry out the work in that way. They assured us that it is very difficult to change the laws of France.

One of the Members of the Congress told me, just before we left, that the Minister of Public Works had agreed to a large appropriation for this work, that they appreciate the fact that there is a vast quantity of this work to be done, and it should be done quickly, and that they wish to get as many people working as possible. We left with the

committee a complete set of standard specifications for the various types of road construction used in this country, and full information concerning the various methods of financing highway improvements in our urban and rural districts.

After we got through with the final discussions, we drew up a report, following closely the lines which I have indicated, which was submitted to and accepted by the General Congress. I think both Mr. Lewis and myself felt that we had done them some good, but we also felt, quite naturally, that if they had accepted more of our ideas, we would have done them a little more good.

THE CHAIRMAN.—We will now have the pleasure of hearing from Mr. E. G. Spilsbury on the Trip to Lens, and the Coal Mines.

E. GYBBON SPILSBURY, M. INST. MINING ENGRS.—Mr. President and Gentlemen: A visit to the battlefronts and the devastated region in the northwest of France is still a matter of some difficulty, and can only be undertaken with the permission and under the auspices of the French Government.

We were specially favored as guests of the Government, and had attached to our party a Captain of the French Army, who had been engaged on that front during the war, and who made a splendid guide.

The Government also detailed Col. Cuvelet, the Chief Mining Engineer of the Lens Coal Mining District, to accompany us, and give us all possible information about the mines. The Chief Engineer of the Northern Railroad of France was also deputed, to take charge of our transportation.

The first stage of our trip was by rail to Arras, where we had our first sight of what war devastation means. The railroad station and the steel train sheds are a complete wreck. Our train was one of the first through trains to Brussels, which place it was expected to reach in 14 hours. The train preceding ours required 25 hours for the trip, which usually was made in 6 hours. I was informed that the Northern Railroad has 320 bridges to rebuild on its system alone. The army cars which had been ordered to meet us at Arras were delayed, and this enabled us to go through the town and see the damage which had been done.

The Cathedral, which was one of the most beautiful in Europe, is a mere heap of ruins, with the exception of one part of the chancel. I was very glad to note a large placard in front of the ruins, warning the public against touching or removing any of the carvings, as the French Government had taken charge, and proposed to keep it as a monument of Hun savagery.

The main square around the Cathedral does not at first sight appear to have suffered entire destruction. The fronts of the houses are more or less intact, but on closer inspection it is evident that the Boches carried out their system of absolute destruction with every

possible refinement of devilish ingenuity. In most cases the beams were cut through so as to drop each floor with all its furniture into a heap of ruins. This certainly was not war.

From Arras we drove out to Lens by car, visiting the battlefields of Vimy Ridge on the way. The whole country is a man-made desert. Not a house, not a tree remains intact, and the surface of the ground itself has been literally shot to pieces. Field after field covered with shell holes so close together as to overlap in many cases. When we add to all this the hundreds of trenches covering the whole area like a huge spider's web, it soon becomes apparent that the work of restoration of the soil for cultivation is a matter of years or decades. The surface soil has everywhere been blown away, and nothing but the white chalk formation remains. Finally, after much floundering through mud holes, we crossed the remains of the Somme Canal and were in Lens, or rather the spot where Lens once stood.

Of the town itself and the sixty or more mining shafts, not a building or head-frame remains standing, everything is levelled with the ground. Yes, there is one eminence remaining, the pile of débris caused by the destruction of the Cathedral, up the sides of which one can climb and from the top obtain an unobstructed view of the whole area of devastation. Terrible as this is, however, it was the fate of war, and the destruction was caused by both the contending armies, but the destruction of the mines, with the view of preventing, or at least retarding, for years their future operation, and so crippling the whole of the French industrial life, is far worse than the mere razing of the houses.

In the Lens district, there were in all some sixty mines, large and small, but the main operations were carried on by the Société des Mines de Lens, who were operating eighteen shafts before the war. Sixteen of these shafts were models of modern mining appliances. The buildings were all stone or concrete and the head-frames were steel structures, around which were grouped the washeries and grading machinery, with massive steel and concrete storage bins, chutes, and loading devices.

Of all this nothing remains except tangled masses of broken and twisted steel. Not content with letting these structures take their chance of being wrecked by shell fire, the Huns went systematically to work and cut the steel supporting legs of the head-frames with acetylene torches, and then, attaching cables to heavy motor trucks, they pulled the whole structures over. Every hoisting and pumping machine was either dynamited or broken up with sledges, and every boiler shows signs of having been exploded from the inside, besides the shell perforations in some of the steam domes. The electric motors and generators were not destroyed, but were taken carefully away and presumably shipped to Germany. They next proceeded to flood the mines by cutting ditches to some of the shafts, and laying pipes to

the more distant ones, through which they turned the waters of the Somme Canal.

The attempts made to dynamite the shaft curbing were apparently not very effective, for, as far as can be ascertained, this damage does not appear to have reached below about 150 ft. Of course, what they may have done in the lower workings before abandoning their operations will only be found when the mines are pumped out.

The Société des Mines de Lens, as soon as they established the extent of their surface damage, immediately set to work and have placed orders in Switzerland and the south of France for an entire re-equipment. Their orders were placed at the close of 1917, and deliveries are expected to begin in March or April of this year.

As there will be little or no coal available until the mines are de-watered, they propose running their pumping machinery by electricity.

It is estimated that it will take 30 000 h. p. for a full year and a half for this de-watering. They have a small surface coal deposit about 12 miles from Lens, where they are now building a power station from which to run the pumps.

It is expected that coal mining in the upper seams will probably begin in about a year.

One of the great difficulties will be the clearing away of the wreckage, owing to the habit the Germans had of connecting pieces of structural material with mines or explosives. The whole place is also full of unexploded shells and grenades. Hardly a day passes but some one is injured by these explosions.

After leaving Lens we drove over to Bapaume, another of the devastated cities. The English forces are doing good work in clearing up around that section, using Chinese coolies and Assamese for the work. They are also rebuilding the roads in good fashion.

It was sundown before we left Bapaume and practically dark when we reached Albert, which is probably the worst destroyed city of its size on the whole front. The destruction is so great that even the streets are in places obliterated, and it took our drivers nearly an hour to find their way finally to the railroad tracks where our special cars were waiting for us; we finally reached Paris late in the evening.

There is one thing that I want to impress on you, and that is, that the French people are not lying down and waiting for the expected amounts that they will receive from Germany before starting to reconstruct the work upon these lands.

Another thing was very apparent to us, and that is that they are not seeking the help of any foreign engineers to aid in this work. They have plenty of talent of their own, and they are going to use it.

THE CHAIRMAN.—The subject of Agricultural Engineering and Sanitation will be discussed by Mr. George W. Fuller.

George W. Fuller, M. Am. Soc. C. E.—The return of peace means readjustment problems for all nations, but differing in kind and degree. To France, the close of the war means the development of commercial and industrial procedures so that the annual budget, including its various political subdivisions, may be increased to a sum 10 000 000 000 francs in excess of what it was before the war.

This is of the essence of the French problem of reconstruction.

The Engineering Congress convened at a time when transitional procedures following the armistice were scarcely under way. Transportation facilities in France were more severely strained than during the war, owing to the need of rationing the civilian populations of Belgium, Alsace, and Lorraine, as well as the armies of occupation along the Rhine. Rehabilitation programmes for the devastated area naturally were awaiting the determination of the Peace Conference, and general conditions were somewhat apathetic in consequence of the coming parliamentary elections.

A struggle for commercial supremacy must be prepared for by France. Generally speaking, it was the practical aspects of modernizing and expanding the commerce and industry of the country, rather than the technical details of engineering, which occupied the attention of the Congress.

Agriculture is one of the basic sources of wealth of the nation, and the agricultural section devoted much attention to discussion of improving banking facilities. Fortunately, French farm lands are mortgaged to only a relatively slight extent. Working capital is needed by the farmers, and this is true of long-term credits, which the French members of the Congress hope may be obtained by farm bonds secured by mortgaging co-operating groups of farms, with the bonds placed on the open market under Government supervision. Short-term loans to farmers and others are now limited to 90 days, which is too short for the agriculturist, who is also handicapped by antiquated procedures for obtaining chattel mortgages on unmovable property. The French members were interested in learning the details of procedures in America, as an aid to formulating an agricultural bank in France.

American customs as to handling meats in central slaughter houses, in conjunction with cold storage plants and refrigerator cars, could be adopted advantageously by the French. The same is true as regards the more general use of drying for the preservation of fruits. A new process of concentrating and sterilizing grape juice and cider was explained by the French, who pointed out the advantages of transporting the reduced volume of the product and the ability to dilute it and ferment it with selected cultures in accordance with the teachings of Pasteur.

Agricultural implements have disappeared from the devastated areas, and are greatly depleted throughout France. Munition factories

will be converted to the manufacture of some lines. The French had a great variety of pipes, of equipment, and of detailed parts thereof. Standardization has made practically no headway, as is necessary for quantity production. For some equipment the French would like to see Franco-American concerns established. This has its advantages and difficulties. Each proposition, from financial, commercial, and engineering standpoints, should be carefully investigated on its own merits.

The French are well informed on scientific agriculture, and such topics were discussed practically not at all. It was along the commercial lines that the French members desired to hear concerning American experiences.

Rural sanitation in France—as elsewhere—is largely a question of an effective campaign of education. The French members were interested to learn of steps taken in America to teach personal hygiene in the schools with the aid of instruction to the teachers at conventions held at frequent intervals. The same was true of steps taken by public health authorities to stimulate interest in sanitary matters on the part of health officers and residents of the rural districts.

Assistance can be rendered by Americans along these lines, although it is a slow task to change the views of a nation so strongly individualistic as is France. In reference to this, it is well to bear in mind that France is a nation of home owners. The law of primogeniture disappeared with the French Revolution, and at about the same time a law was adopted prohibiting the disinheritance of a child to the extent of more than 50% of its heritage. This has much to do with an appreciation of the character of the French soldier, who has been fighting for his home, small though it may be, and the conduct of which has conservatively followed the customs of earlier days.

The Chairman.—The next topic on the programme is "Hydro-electric Development and the Grenoble Trip." I am pleased to introduce Mr. L. B. Stillwell, representing the American Institute of Electrical Engineers.

L. B. Stillwell, M. Am. Inst. Electrical Engrs.—Mr. Chairman and Gentlemen: The Water Power Committee appointed by the delegation of American Engineers was composed of Mr. Hunt, Dr. Swain, Mr. Main, and myself. The Chairman of the Water Power Committee of the Congress was M. Blanchet, chief administrator of one of the important French railways, and a man who is exceedingly well informed as to the general problems of water power development.

The Committee, after having held several sessions in Paris on December 19th and 20th, arrived in Grenoble on January 5th, and a long session was held in the afternoon of that day, during which several engineers explained and described the projects for the development of water power, particularly in the Valley of the Upper Rhône.

Following our return to Paris, another session of the Water Power Committee was held at which other projects were described, for the consideration and discussion of the General Committee.

The water power of France is found principally in three districts or regions: The region of the Alps, drained by the Rhône and its tributaries, and which is the most important; the region of the Pyrenees, in regard to which our information is far less complete, as we did not have time to visit that part of the country. This is said to be second in ultimate importance, although, by reason of the distance of that region from industrial centers, the utilization of power has thus far been very much less than in the region of the Rhône. Then quite recently the water powers of what is known as the central massif of France, the high land south of the Loire, and in central southern France, have been receiving considerable attention, and though the streams are not very large, and the head is less than in the Alps and the Pyrenees, the aggregate of power available is considerable, and its location is highly favorable.

The total horse-power of France, in round numbers, based on the estimate of French engineers as to what proportion of the power is, or will in the near future be, commercially developable, is from 5 000 000 to 6 000 000. I believe it would be safer to consider 4 500 000 h. p., as the total that may be commercially developed, and 9 000 000 h. p. as the total available for 6 months of the year.

The coal consumption in France in the average year immediately preceding the war was about 60 000 000—it was 62 000 000 tons in 1913. Of this total about two-thirds are produced by French mines and one-third is imported. The average price prior to the war was from $5 to $6 a ton. The judgment of the engineers with whom I talked was that a considerable number of years would elapse, following the termination of the war, before the price of coal will be below $8 a ton. It is obvious, therefore, that there exists an extremely practical and cogent reason for the prompt development of French water powers as a substitute for the use of coal. Beyond that, of course, the French, who are never lacking in vision, realize the tremendous effect, on the wealth of the country, of industrial development dependent on power.

In the United States, as you know, the figure before the war representing the output of our industries was about $1 500 per h. p. used by American mills and factories. If you could utilize even one-half the water powers of France, the immense value of the factories and mills which could be supplied with that power can be easily imagined, and the number of operatives required by these mills, according to the figures prevailing in the United States would approximate 500 000.

The vicinity of Grenoble is the heart of the present water power development of France. Our delegation was divided into two parties, one party ascending the Valley of the Isere, while the other explored

the Valley of the Romanche. In the Valley of the Isere there is much of historic interest to the hydraulic engineer. The little town of Lancey, not far from Grenoble, is the birthplace of the utilization of hydraulic power under high heads in France.

In 1868 a young man solved the problem of utilizing the water power of the stream under a head of 200 m. There was a small mill there which was utilizing about 4 m., but he realized that if he could only produce the right kind of a wheel he could multiply that power enormously by taking the greater head, and in one year he succeeded in producing a wheel which, for the time, was certainly a marvel, a wheel of special construction, which is now on exhibition in the museum at Lancey, which in its essential elements has been duplicated since and is still in operation.

It was also in the immediate vicinity of Grenoble that the early experiments of Deprez were made which developed the necessity of using high pressure in order to secure wide distribution of power, so that this particular section of the country is one of great interest.

The establishment of Aristide Berges, at Lancey, where the development I first spoke of was made, and the establishment of Fredet on the same stream farther up, were visited by the Committee. The establishment of Fredet is a plant that is thoroughly modern in respect to nearly all its elements. Originally a paper mill, it has been expanded under the stress of the war emergency, and is now making calcite carbide in large quantities. They have just completed a modern plant for the manufacture of cyanide.

We can teach the French practically nothing in the technique of the hydraulic art or the construction of factories. The only matters they may have to learn from us are those which rest on the fact that our experience has been on a somewhat broader scale; that our units are large; that the pressures we have adopted in some cases are higher, and therefore we have had the opportunity of testing our theory by practical experience, which thus far they have not had. It is in that respect only, I think, that they can derive ideas from us which may be useful to them in their programme, so far as power is concerned.

In the Romanche Valley there is a plant now under construction which will utilize in one step a fall of 1 100 m., about 3 600 ft. The diameter of the pipe is 18 in. That, I think, is a higher head than we have attempted as yet in the United States.

The other plant of special interest, about which Mr. Spilsbury can answer questions better than I can, is one near Grenoble where they are using an electrolytic process to make iron pipe by depositing iron on revolving drums. This gives, of course, a chemically pure iron, and where particularly light structures are concerned, it is said to have material advantages and to be not prohibitive in cost.

One thing that is notable over there in regard to their utilization of water powers is their tendency to take the industry to the water power. In the tributaries of the Rhône there are many plants; not many of them are large, but they are numerous, and the processes in electro-chemical work and metallurgical work are varied and extremely interesting. The ratio of installed capacity to the average low-water flow, is about 3.5, which indicates that they are in many cases using power for less than 12 months in the year, and find it advantageous to put in apparatus even where the water is not available all the time.

Apparently, they have not thus far given a great deal of attention to the combination of steam power with water power. There are considerable deposits of coal, but of very poor quality, in the immediate vicinity of water power.

In our preliminary report we called attention to the fact that the ultimate solution of their problem would probably be to connect some of their coal regions with their water powers, and utilize the steam plants to convert secondary power to primary power as the demand may grow.

We saw at Grenoble several of the sub-stations at which power was received by transmission from the Alps, and we were particularly interested in examining the famous Thury system, which has been in operation now for some 20 years. That plant, as you may remember, utilizes continuous current at a constant rate of about 130 amperes, the voltage varying from 40 000 to 65 000, depending on the load. The receiving apparatus consists of pairs of motors, each motor having a potential of 3 500 volts across its commutator, a number of these pairs being connected in series. At low loads the efficiency of the system must be far from satisfactory, but the plant has been constructed with very great care and skill, as shown by the fact that in all these years they have had only one fatal accident in handling their high potential.

I noted, however, on the same pole line which carries the direct current, that there are conductors for the alternating current system, and they are now using six conductors, two 3-wire circuits for alternating current at 45 000 volts, through which they are transmitting 15 000 kw. as compared with 10 000 kw. for the direct current, showing that, having tried the direct current, they have swung over to the alternating three-phase current, as generally used in America.

The Durance, a tributary of the Rhône, is a stream of highly variable flow, and the importance of its proposed development rests, not only on the possible output of power, but also on the fact that irrigation is greatly needed in the lower part of this water-shed. A very elaborate plan for the development of the Rhône for these several purposes was described to us.

As regards the electrification of railways, the French have not done a great deal, although they were among the first to apply electricity to railway operation. M. Sabouret, Chief Engineer of the Paris and Orleans Railway, read an admirable, brief paper describing the present condition of the electrification of the railways. I was interested to note that the history of the application of electricity to haulage in France illustrates in a striking way the old adage that "a prophet is not without honor, save in his own country". The electric locomotives for the operation of the Baltimore Tunnel of the Baltimore and Ohio Railroad were introduced about 1898, certainly prior to 1900. The French company sent engineers over here to examine the operation of the railroads, and they reported that the solution of the problem of the haulage of trains from the Austerlitz station to the Quay D'Orsay was perfectly clear, that the electric locomotive should be used, and since 1900 they have been operating trains between those two points in that way.

During later years, when the Pennsylvania Railroad was considering the electrification of its terminal in New York City, the Vice-President, knowing that Mr. Cassatt, the President, was in France, cabled him that the French were using electricity to haul trains on the Orleans Railway, and Mr. Cassatt examined it and reported back that the problem was solved.

Prior to the War, the French engineers were making careful study of the problems of electrifying the Midi Railway, and contemplated some elaborate tests. The War stopped all that, but they still have it in mind, and engineers representing three of the French railways expect to come here soon to see what we have been doing since they last examined the work in America. They do not expect to electrify their entire systems, of course, but there are certain sections of France, where the roads within reach of water powers, and other sections where the traffic is dense, which they think it will pay to electrify.

They have taken up one thing in France recently, as the result of the sessions of the Engineering Congress held in March, and that is they are making a serious effort to standardize frequency and potential. Hitherto they have used a great variety of potentials and a considerable variety of frequencies. The individuality of the French engineer leads him to have his plant different from that of "the other fellow", if possible, but they realize now that a continuation of this policy will be disastrous to any scheme of linking up the sources of power, as they will have to do one of these days, in order to have one unified system, fed from all available sources of power. Therefore, at the last session in March it was recommended that a frequency of 50 be adopted as the standard, a frequency of 25 being permitted for special cases.

They will have to carry the idea of standardization through, if they wish to get the costs of production down to a reasonable basis. They

carry the idea of individuality to an extreme that is astonishing to us. The small manufacturer who makes a lamp socket, for example, or the dealer who retails lamp sockets, will call on the manufacturer to make his a little different from others, on the theory that, having secured his original customers he can hold them, as they cannot get that particular type anywhere else. That practice does not tend to reduce costs. They realize this now, and they are going to make an effort to overcome the difficulty.

As regards the laws under which water powers are utilized, the French are in very much the same position as we are. They are seeking for a general law governing water power relations. The power developments heretofore have been made either under authorizations which are revocable or under special concessions which are not always easily obtained. They now have in the House of Deputies a bill to establish a general law of concessions under which it is hoped that capital will be attracted to the development of their water powers, as they have not heretofore been developed on a scale commensurate with their possibilities.

The Chairman.—The next speaker is assigned a double duty, to speak for himself on the subject of "General Remarks Regarding Ports and the Marseilles Trip", and also say a few words for Mr. Charles T. Main, who is absent and was to speak on the subject of the "United States' Activities at Bordeaux and St. Nazaire". I will introduce Mr. A. M. Hunt.

A. M. Hunt, M. Am. Soc. C. E.—Owing to the absence of Major J. F. Case, who was Chairman of the Committee on Ports, I have been asked to comment on this subject.

The French authorities have distinctly in view an effort to make their ports serve, not only the needs of France, but to make them ports of entry for middle Europe. To accomplish this, they contemplate an east and west railroad line from one or more of their Atlantic ports, over which freight arriving at such ports can be expeditiously and economically carried across France to some point in Switzerland, for instance Basle, and from such point to destination.

An ambitious project is being talked of, which contemplates making St. Nazaire the port of entry, from which place a very easy grade up the Loire River and to Basle can be followed. By utilizing existing railway lines, this route could be established in a minimum of time.

The French engineers realize that if they are to capture this trade, which before the war went through German ports, they must act promptly. To this end, this project contemplates taking over the plant which our Army has been constructing near St. Nazaire to supplement the previously existing facilities at that port.

These old facilities, which consist of a wet basin, with locks, would be wholly inadequate for this project, for, even prior to the War, they

were fully engaged in handling the imports intended for French consumption which entered this port. The new facilities, constructed by our Army, include a very extensive system of warehouses, with tracks and yards. There was under construction, at the time the Armistice was signed, a large pile wharf, which was designed to afford berthing space for, I think, ten vessels. The approach from the shore to deep water was completed at the time of our visit, and work was being done on the pier head, which was to be extended so as to afford about half the number of berths originally planned.

The range of tides at the Atlantic ports of France is from 6 to 8 m., or 19 to 26 ft. For handling vessels and discharging them, the French engineers have in most cases limited themselves to wet basins with locks.

The necessity for prompt action, and the greatly reduced costs, have made them take a lively interest in the possibilities of the methods which our Army engineers have used, and it seems probable that these methods will be at least considered seriously in the future.

The French engineers requested a report on the subject, with data as to the handling methods at American ports having extreme ranges of tide, and such a report will be sent them by members of our delegation.

Our Committee made the following recommendation in our written report to the Congrès du Génie Civil:

"The Committee believes that the Congress would do well to study the methods in use in America for loading and unloading facilities alongside the wharves, even where there is a considerable range of tide, without the use of enclosed basins entered through locks. Experience in our ports and at Panama has demonstrated that locks are not necessary even when the range of tide is very considerable. If the docks are equipped with proper mechanical devices for loading and unloading it makes little difference whether the vessel stands high or low at the dock. The Committee will not attempt to fix the limit of tide above which locks should be used, but at some American ports they have not been found necessary with a range of tide of 6 or 7 m."

The French engineers also desired specific information regarding floating docks. Information as to our practice in this line is being secured and will be sent to them.

Both Nantes and Bordeaux, which are old established ports, are some distance from the sea, up rivers. As the draft of vessels has increased, they have found themselves handicapped by the limited depths of water in the river channels.

Nantes is about 30 miles up the Loire River. Its handicap has led to the establishment of a port practically at the mouth of the river, the port of St. Nazaire, which is growing rapidly. Nantes has tried to hold its own by deepening the river channel, but St. Nazaire is destined to become the port for vessels of the largest type.

We also visited Marseilles, which is the main French port of entry on the Mediterranean. Its harbor is essentially an artificial one, except for what is known as the old port, which dates back to the days of the old Greek pirates in the era before Christ. The main harbor consists of a series of inter-connected basins formed between the shore and a stone breakwater which parallels it. As the tidal range is small, locks are not used.

The French members of the Congress were very much interested in learning of our methods of port administration, whether by the State, the city, the railroad companies, or the steamship companies. A report on this subject was promised them.

We arrived in France at Bordeaux and left from the same port. It suffers from the same handicap as Nantes, being about 60 miles up the Gironde River.

Some port facilities exist lower down the river and at its mouth, and it seems probable that these will be developed for the use of the largest vessels. The range of tide here is also great.

Our Army has done much construction work at this port and in the vicinity of Bordeaux.

There is a very large supply station at St. Sulpice, only a few miles out of Bordeaux, which we visited, where there is a very extensive system of warehouses and yards. It was a main supply point, and carried supplies for a million men for two months, as I recall the figures given us.

Just outside of Bordeaux there is an institution through which we were shown by the American Officer who took us over the American works around Bordeaux. He called it the "Mill", and explained that it was for making new men out of old ones. Soldiers arriving at Bordeaux for shipment home, are received at this "mill", leave all their old equipment and clothes, are cleaned, examined by medical officers, receive a complete new outfit, and are ready for the trip home. They go in, in line, at one end, dirty and disreputable, and many of them infested, and, after being passed along the line for about one-quarter of a mile, come out self-respecting soldiers once more.

The Chairman.—The final speaker is Mr. Nelson P. Lewis, and his general subject is "The Chateau-Thierry Trip and General Impressions of the Conditions in France".

Nelson P. Lewis, M. Am. Soc. C. E.—I was asked to say something of the visit to the Marne Valley and Chateau-Thierry. It was a notable visit, on the one day of our stay when the sun shone, and on one of the two days when it did not rain. We saw the sun rise that morning, when well outside the limits of Paris, as we followed the direct road to Meaux, one of the main roads of France, the trees along which had been cut down in order that they might not furnish a target for hostile air raiders, but new trees have already been planted.

At Meaux we crossed the Marne and followed its "smiling valley" as far as Le Ferte, where we recrossed it and bore to the north and then to the east. Turning into a side road we soon saw the first evidences of destruction at the little hamlet of Lucy de Bocage.

The village and, of course, its church, were completely destroyed, and just beyond we passed a little graveyard containing seventy-five or one hundred of our boys, each mound having a wooden cross, with a disk on which were American colors.

Then over the hill, and down to the hamlet of Belleau, through the ruined chateau of which we wandered, and were cautioned not to pick up anything, as a number of accidents had occurred, through indiscreet visitors picking up hand grenades or other objects which had been wired to bombs, and the results were disastrous.

Then we followed the road through the Belleau Woods, well shot to pieces, past more cemeteries and more pathetic little graves, and down into Chateau-Thierry itself. There is something left of the town, and there are a good many people still living there. Having lunched at a little old-fashioned inn, we crossed the river over one of the new steel bridges built by our engineers, in place of the wrecked masonry arches, and followed up the valley of the Marne, passing through Gland, Jaulgonne and other villages almost completely wrecked. Leaving the river, we went north to Cierges and Sergy, which were completely wrecked, and then to Fère-en-Tardenois, which figured so largely in the war reports.

From there we followed the direct road to Soissons across a country less interesting than the Marne Valley, but passing great munition dumps, containing hundreds of thousands of shells which had been ready to be sent to the front on the light railways, but in the hurried departure were left behind.

Soissons must have been a very attractive town, more like one of our American cities than anything else we saw, with stately detached houses set in spacious grounds, but nearly all wrecked, none inhabited. Of course, the churches were completely destroyed. From there we followed the Aisne to Compeigne, but it was growing dark, and as we passed through the great forest and through Senlis and back to Paris we saw nothing of the landscape.

The contrast between the Marne Valley and the British front, described by Mr. Spilsbury, is quite striking. Along the British front there was a picture of absolute desolation which held out little hope of restoration. The natural beauty of the Marne Valley still remains, and there seems to be an encouragement to rebuild. I have no doubt that the fertile soil of that country and its natural beauty will soon prevail over the wreck of war.

Now, a few words on general impressions: First, let me speak of the social conditions which have been caused by the War. The most con-

spicuous of these, perhaps, is the separation of families. The entire Northern war zone is depopulated; the able-bodied men were in the army and all the others have gone elsewhere, most of them to Southern France, where they have been employed in war industries, earning more money than they ever dreamed of before, and living in a more equable climate. The great problem is whether they will want to go back. The homing instinct of the French peasant, noted by Mr. Fuller, is not so strong in the farm laborers or industrial workers, and it is a very serious question whether this district can be populated again.

In talking about the social conditions, we must take into account the change which has come over the women of France. They have been wonderfully brave and loyal, and it was pathetic to us at first to see them doing the hard, rough work of porters at the railway stations, but they looked well and well-nourished, and it does not seem to have disagreed with them.

We went through one exceedingly interesting plant, built up by a French captain of industry, M. Citroen. It is a great munition plant, and the problem now is to convert it to a peace basis. His employees were very largely women, and he has done some social work of an extraordinary character.

The French population is not going to die out if M. Citroen can help it. There is a lying-in hospital as part of his establishment, and the women when they have to go there do not stay very long. When they return to their work he allows them a bonus of 10 francs a month for as many times a day as they go out to nurse their babies. We were told that some women get extra compensation of 50 francs a month for nursing their babies five times a day. M. Citroen said that 140 babies had been born in his plant, and not one had died, although the infant mortality, generally speaking, is more than 30 per cent.

These women were said to earn $5 a day; they have had a taste of economic independence. Will they be willing to return to the old conditions? That is a problem which confronts not only France but the other countries which have been engaged in the war.

The industrial situation has been outlined, perhaps quite fully, by the other speakers. The Northern war zone of France is wrecked and depopulated. In Southern France new war industries have been developed, and they have to be converted to peace industries. There will scarcely be an immediate revival of the fine art manufactures and the production of luxuries for which France was famous before the war, but they must turn their attention to the essential things that France needs in order to live and to recover its prosperity; and that involves an exceedingly serious problem.

There is, then, an unbalanced industrial country; a part of it almost depopulated, the other part developed with a series of industries

new to France and not now needed; and these must be replaced by others.

As to the extent of the damage to industry, we were furnished some figures, and I have taken only those which were most conservative. Some of the estimates are far higher. The devastated area covered 6 000 sq. miles, and in that district it is estimated that 500 000 buildings were damaged; one-half of which were totally destroyed. It is estimated that 500 000 men of the building trades would be continuously employed for 15 years in restoring these buildings.

Reduced to money, the estimated damages are about as follows:

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| Buildings destroyed or damaged | $4 000 000 000 |
| Furniture destroyed or stolen | 1 000 000 000 |
| Public works wrecked | 2 000 000 000 |
| Farm lands damaged | 800 000 000 |
| Live stock, agricultural implements, and forests | 1 200 000 000 |
| Mines and steel works | 700 000 000 |
| Miscellaneous industrial machinery and raw material destroyed or stolen | 4 000 000 000 |
| Total | $13 700 000 000 |

This does not include Belgium, and we must not forget Belgium. When we think of Belgium we think of Louvain, and Dinant, and Ypres, and we think of Albert—the gallant King who gave that stirring reply to the demand of the Huns that they might be allowed to cross his territory, when he said, "No; Belgium is not a highway; it is a sovereign state". We must not forget Belgium.

Now, is this amount, representing, not the cost of the war to France, but simply the physical damage sustained by her, to be paid by Germany? It should be paid to the last dollar; notwithstanding the whine we hear from the other side of the Rhine. Notwithstanding the somewhat disturbing news, which appeared in to-day's papers, that the body which is to deal with the question of terms for extending the Armistice is to have a more civilian cast, and that the great General, under whose unified command this victory was won, and would have been completely won if he had had another fortnight or three weeks, should not figure quite so prominently. The fruits of his victory must not be thrown away. The bill must be paid, and paid to the uttermost farthing.

THE CHAIRMAN.—Gentlemen, the hour is late, and it is understood that this presentation is informal and preliminary to reports which will be made later. I believe these gentlemen will be glad to answer any question, and the subject matter is now open for discussion. There being no discussion the Chairman declares the meeting adjourned.

### Vol. LXXXII of *Transactions* Has Been Mailed

Vol. LXXXII of *Transactions*, the volume for 1918, was forwarded to all the members of the Society during the week ending February 1st, 1919, except to those who had asked to have their publications held, or who were in arrears for dues.

Any member of the Society entitled to this volume, who has not received it, will confer a favor on the Secretary by notifying him of this fact.

### Co-operation of the Government in the Restoration of Construction Activity

In the Department of Labor at Washington a new division has been created, known as the Division of Public Works and Construction Development, of the Information and Education Section, its object being to promote the restoration of building and engineering construction throughout the country.

During the war the building industry was subject to severe restrictions, and the creation of this division is an evidence of the purpose of the Government to restore this industry to normal conditions. All governmental restrictions have now been removed.

An investigation is being organized, and communication will be established with architects, contractors, manufacturers of building materials, authorities of States and municipalities, etc., in order to ascertain what buildings are under contemplation, the present stage of the projects, the progress being made, the capital available, the labor supply, and the bearing of present land and rental values on the problem. An effort is to be made to relieve building operations from the embarrassment of strikes and controversies, to encourage the development of existing projects, and to give reasons for undertaking new projects.

It is believed by many that the present high prices of labor and building materials, which have checked building operations, will fall within a short time, and this belief is doubtless the cause of the present inactivity in building. This new division will investigate prices and the causes influencing their fluctuations, and it may be disclosed that these prices will not be reduced as soon as expected, in which case it will be wise to build now, when buildings are needed, and thus secure the benefit of present high rentals.

The President, in his recent address to Congress, stated it to be important "that the development of public works of every sort should be promptly resumed."

The Treasury Department has just issued plans for thirty-seven public buildings in different parts of the country, indicating the purpose of the administration to proceed as rapidly as possible with the

peace programme of building. It is expected that Congress will authorize, at this session, a $10 000 000 programme of construction for the Public Health Service. It is also expected that River and Harbor projects will be prosecuted diligently. It is hoped that this example set by the Government will be followed by States and municipalities.

Many businesses are now in absolute need of additional space, and their work is being conducted at a disadvantage, the loss in the development of business being far greater than the increase in the present cost of construction. This is particularly true of railroads which are now urgently in need of improvements and extensions. Much might be said, also, in favor of constructing monumental business structures, and of home building. It is believed that the new division, after a complete investigation, will be able to take up the problem of the building of homes.

### Public Works Planned for 1919

According to reports made public recently by the War Labor Policies Board at Washington, fifty or more of the larger cities of the country have estimated that they will spend approximately $122 850 000 for public works and buildings. This information was received in response to inquiries by the Board, which wished to know how much employment could be provided for returning soldiers and war workers. It shows that 12 cities in the eastern district are prepared to spend $46 543 000; 13 cities in the central district, $41 248 720; 9 cities in the western district, $30 521 000; and 6 cities in the southern district, $4 537 000, with many cities yet to report.

Among the cities and the sums reported were:

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| Boston | $8 400 000 | Des Moines | $2 200 000 |
| Buffalo | 6 000 000 | Toledo | 2 000 000 |
| Pittsburgh | 5 150 000 | Akron | 2 500 000 |
| Philadelphia | 13 000 000 | Fort Wayne | 300 000 |
| Syracuse | 2 362 000 | Sioux City | 475 000 |
| Springfield, Mass. | 4 015 000 | Chicago | 11 100 000 |
| Worcester | 1 800 000 | Detroit | 4 500 000 |
| Manchester, N. H. | 290 000 | Spokane | 70 000 |
| Savannah, Ga. | 350 000 | Sacramento | 1 800 000 |
| Chattanooga | 600 000 | Seattle | 15 100 000 |
| Memphis | 600 000 | San Francisco | 3 000 000 |
| Atlanta | 2 217 000 | Salt Lake City | 1 150 000 |
| Dayton, Ohio | 730 000 | Los Angeles | 6 258 000 |
| Wichita, Kans. | 750 000 | Tacoma | 2 455 000 |
| Cleveland | 8 100 000 | San Diego | 610 000 |
| Kansas City | 525 000 | | |

### Report of Patent Committee to National Research Council

In 1917, on the request of the Commissioner of Patents, a committee was appointed by the National Research Council to investigate the Patent Office and the patent system, with a view to increasing their effectiveness, and to consider what might be done to make the Patent Office more of a national institution and more vitally useful to the industrial life of the country.

The following Patent Committee was appointed: Dr. William F. Durand, Chairman; Drs. Leo H. Baekeland and M. I. Pupin, scientists and inventors; Drs. R. A. Millikan and S. W. Stratton, scientists; Dr. Reid Hunt, physician; and Messrs. Frederick P. Fish, Thomas Ewing, and Edwin J. Prindle, patent lawyers. On Dr. Durand's departure for Europe, Dr. Baekeland was appointed Acting Chairman.

This Committee, having made a careful investigation, has recently reported its recommendations, and proposed a programme consisting of four features which it considers are of fundamental importance. They are:

1.—A Single Court of Appeals, having jurisdiction of appeals in patent cases from all the United States District Courts throughout the country, in place of the nine independent Circuit Courts of Appeals in which appellate jurisdiction is now vested. A Bill to establish this Court has already been introduced.

2.—The Patent Office to be a Separate Institution, and independent of the Department of the Interior, or any other department. A copy of a proposed bill for this purpose has been submitted by the Committee.

3.—An Increase in the Force and in the Salaries of the Patent Office. The Committee advances strong arguments for these changes.

4.—Compensation for Infringement of Patents. This provision would make it possible for a patentee to obtain more equitable treatment than at present in infringement cases.

### The Washington Award

The Washington Award, founded in 1915 by John W. Alvord, M. Am. Soc. C. E., and administered by the Western Society of Engineers, is awarded annually in the form of a bronze medal or other work of art to "an Engineer whose work in some special instance, or whose services in general have been noteworthy for their merit in promoting the public good." The Commission of Award consists of nine members of the Western Society of Engineers and two members each from the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, and American Institute of Electrical Engineers. The Washington Award for

1918 was made to Herbert Clark Hoover, M. Am. Soc. C. E. The Annual Washington Award Meeting of the Western Society of Engineers is scheduled for the third Monday in February of each year.

### John Fritz Medal Awarded to General Goethals

The John Fritz Medal for 1919 has been awarded to Maj.-Gen. George W. Goethals, M. Am. Soc. C. E., the builder of the Panama Canal.

The previous recipients of this medal have been:

| | |
|---|---|
| John Fritz | 1902 |
| Lord Kelvin | 1905 |
| George Westinghouse | 1906 |
| Alexander Graham Bell | 1907 |
| Thomas Alva Edison | 1908 |
| Charles Talbot Porter | 1909 |
| Alfred Noble | 1910 |
| Sir William Henry White | 1911 |
| Robert Woolston Hunt | 1912 |
| John Edson Sweet | 1914 |
| James Douglas | 1915 |
| Elihu Thomson | 1916 |
| Henry Marion Howe | 1917 |
| J. Waldo Smith | 1918 |

### Letters Relating to Action of the Board of Direction and of the Executive Committee, on Resolutions of Duluth Association, and Addressed to All the Local Associations of Members, by Order of the Board of Direction.

"FEBRUARY 4TH, 1919.

"At a meeting of the Board of Direction held January 13th, 1919, certain resolutions adopted by the Duluth Association of Members with regard to the action of the Executive Committee in selecting six representative Civil Engineers to act as a Delegation in connection with representatives of the other National Societies to take part in a Joint Engineering Congress to be held in Paris in December, 1918, for the purpose of discussing technical matters pertinent to reconstruction work and the development of industry, which invitation was extended by the French Engineers with the approval of the French Ministries of Public Works, of Commerce, and of Armament, were considered.

"The resolutions of the Duluth Association of Members in the first place endorse the action of the Executive Committee in accepting the invitation and sending the Delegation to the above Congress.

"Further, that Association recognizes the peculiar fitness of the Delegation selected, but expresses its opinion that this Delegation, com-

posed of five New York City Engineers and one Boston Engineer, is not geographically representative of the American Society of Civil Engineers, and its belief that the membership outside of New York should have been represented by a larger number of members being selected for this Delegation.

"The Duluth Association further expresses its disapproval of all policies of the American Society of Civil Engineers which do not call for the active participation of the membership outside of New York City.

"Copies of this resolution have been sent to the Executive Committee and the other Associations of Members.

"Several communications have been received from other Associations of Members endorsing the action of the Duluth Association in this matter, and one Association, the Colorado Association of Members, considered the resolutions of the Duluth Association and formally decided that no action be taken until further and more definite information as to why the Delegation was chosen as indicated in the resolutions of the Duluth Association becomes available.

"The Secretary was instructed to draft a letter covering this matter and send a copy of it to each Local Association.

"The Delegation selected consisted of J. F. Case, Chairman, Geo. W. Fuller, Nelson P. Lewis, Geo. W. Tillson, Geo. F. Swain, and A. M. Hunt.

"It might be well to state at first that Mr. Geo. W. Tillson has resided in Illinois for some time, and that Mr. A. M. Hunt, while he has been in the Resident District for some time, especially during the last year or two, being actively engaged in war work with the Naval Consulting Board, was for a number of years a resident of the Pacific Coast, residing in San Francisco, and, of course, as is well known, Prof. Swain is a resident of Boston.

"This is only stated as a question of fact, and, of course, had no real bearing on the reasons governing the selection of these gentlemen. There were several things to be considered in the matter. One was especial fitness for the subjects which the French Engineers indicated would be discussed.

"Second, the securing of properly qualified Engineers whose engagements enabled them to arrange to make the long trip in a very short time.

"Third, the necessity for the securing of necessary passports and of having the Delegation properly accredited to the American Ambassador in Paris.

"The first meeting of the Executive Committee at which this matter was brought up was held November 1st, 1918, six members of the Executive Committee being present, also three other members of the Board. The cable signed by A. Millerand, President, which was addressed to Maj. J. F. Case, was presented. It contained the general information as to the Congress and the desire of the French Engineers to have an American Delegation formed, but the invitation was not in such form that it could be considered as being addressed to the Society. The whole matter was very carefully considered, and while all present were very much in favor of doing anything possible, the general feeling was expressed that the invitation should be somewhat more

formal before final acceptance was made. Some cables were exchanged, and the matter was cleared up on or about the seventh of November. The other three Societies were communicated with and all of the gentlemen who finally accepted were communicated with. One Engineer who had been asked, and who had agreed to go, found it necessary, due to other engagements, to decline subsequently.

"It should be borne in mind that the date of the Congress had not been definitely fixed, but the French Engineers had indicated that about the 14th of December would be satisfactory to them, and in order to meet this date it was necessary that the Delegation should go on a steamer whose date of sailing was December 3d. Application had to be made to the State Department for passports, and, as a matter of fact, the application was refused and considerable delay resulted. One of the Delegates from one of the other Societies, and one of those from this Society, did not get their passports until upon the eve of the final sailing which did not take place until December 5th.

"It is the belief of the members of the Board and of the Executive Committee that these conditions were not understood by the Duluth Association, and other Associations which approved the action taken by the Duluth Association when they were giving the matter consideration. There was no thought in the minds of the Executive Committee except that of fulfilling the obligation accepted by the Society when the invitation was accepted, and if an effort had been made to communicate with various parts of the country to ascertain by action of Local Associations, or otherwise, members who would be more widely separated and would still represent the Society in the special subjects designated by the French Engineers, it is exceedingly probable that a Delegation could not have been gotten together in time.

"All of the Delegates except Major Case, have now returned to this country, and it is hoped that a formal report of their operations will soon be presented to the Society.

"Your respectfully

"CHAS. WARREN HUNT,
"*Secretary.*"

"JANUARY 31ST, 1919.

"At a meeting of the Board of Direction of the American Society of Civil Engineers, January 13th, 1919, preamble and resolutions adopted by the Duluth Association of Members at a meeting held December 28th, 1918, relating to the Committee on Development in regard to the postponement of its proposed meeting on January 13th to 18th, 1919, these resolutions having been forwarded to all members of the Committee on Development and to all Local Associations of Members, were considered. I am directed by the Board to state briefly the attitude of the Board in the matter, and for the information of the Local Associations of Members.

"While the finances of the Society were temporarily not in very good condition owing to remission of dues on account of war service, lack of income from non-rental of old quarters, etc., as stated in the Annual Report of the Board of Direction which will be published in the January Number of *Proceedings*, this condition did not have

so much to do with the question of the holding of this proposed meeting as certain other matters.

"Quoting from a letter of a member of the Executive Committee of the Development Committee, and who is a Chairman of one of its Sub-committees:

"'If it were necessary that the Committee should hold a meeting at the time of the Annual Meeting, its members—such is my impression of them—would not hesitate to take the chance of reimbursement for mileage at such time as the Society would be able to afford it. The point is, that the proposed meeting is really not warranted.

"'The Committee's work is now in the sub-committee stage. The sub-committees are entrusted to collect, digest and present intelligibly to the main committee all reasonably available facts and views pertaining to their special assignments, so as to enable the main committee to form and pass correct judgment. Presumably the main committee does not wish to arrive at its conclusions by incomplete or mistaken information. In the case of the sub-committee of which I am chairman, the proper presentation of its special problems will require the arraying in order of facts relating not only to our own society but to other societies of a similar kind. Considerable time and labor are required and yet the work is hardly begun. * * * I have no doubt that other sub-committees are in similar case.

"'The next meeting of the Committee will be warranted only when the sub-committees are ready to report. There is no chance whatever that mine will be ready to report at the time of the Annual Meeting. In fact, a decent respect for the resolution authorizing the appointment of the Committee involves the recognition that the discussions to be elicited at the Annual Meeting are expected to form an important part of the data to be considered by the sub-committees before they report.

"'This incident is especially interesting to my sub-committee since it has a direct bearing on one of the most important questions to be studied by them.'

"I am quoting this because it seems to me it is a better statement than I can make of the matter, as I am not at all familiar with the work of the Committee on Development.

"I am also directed to quote from a letter dated January 10th from the Secretary of the Committee on Development:

"'I have received copy of resolution adopted by the Duluth Society of Members of the American Society of Civil Engineers on December 28th, protesting against the postponement of the meeting of the Development Committee and beg leave to call attention to one omission in the second paragraph of this resolution which was one of the primary motives guiding the Executive Committee of the Committee on Development in postponing the meeting, viz: that the work of the Committee through its sub-committees had not reached a stage from which sufficient benefit would be secured to warrant the relatively large expenditure which would be necessary to defray the expense of the meeting. The Committee feels that it has an obligation to the Society to render value received for expenses incurred and it is conscientiously endeavor-

ing to promote the work of the Committee as rapidly as possible, consistent with this responsibility.'

"It is the hope of the Board of Direction that this letter will be presented to the next meeting of each of the Local Associations so that the members may be advised in regard to this matter.

"Yours respectfully

"CHAS. WARREN HUNT,

"*Secretary.*"

## ANNOUNCEMENTS

**The Reading Room of the Society is open from 9 A. M. to 10 P. M., every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day.**

### FUTURE MEETINGS

**March 5th and 19th, 1919.—8.30 P. M.**—Meetings will be held as usual on these evenings, that of March 5th being the regular business meeting of the Society. The arrangements for the second meeting are in the hands of the New York Meetings Committee, and programmes for both meetings will be announced later.

### ENGINEERING SOCIETIES EMPLOYMENT BUREAU

Under the direction of Engineering Council, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, have established the Engineering Societies Employment Bureau, under the management of their Secretaries. One of the purposes of the Bureau is to keep in touch with all engineering firms, with a view of supplying them with desirable men.

Plans are now under way to assist in placing men who are retiring from Government Service.

The Bureau is not intended to be exclusively for the benefit of members of the Founder Societies; non-members who are introduced properly will also be registered.

Further information, registration forms, etc., may be obtained from Walter V. Brown, Manager, Engineering Societies Employment Bureau, Room 903, Engineering Societies Building, 29 West 39th Street, New York City.

### SEARCHES IN THE LIBRARY

In January, 1902, the Secretary was authorized to make searches in the Library, upon request, and to charge therefor the actual cost to the Society for the extra work required. Since that time many searches have been made, and bibliographies and other information on special subjects furnished.

The resulting satisfaction to the members who have made use of the resources of the Society in this manner has been expressed frequently, and leaves little doubt that, if it were generally known to engineers that such assistance could be had, many would avail themselves of it.

On October 1st, 1916, the Library of the American Society of Civil Engineers ceased to exist as such, and was merged in the Engineering Societies Library, adding 67 000 volumes to the collection, which comprises also the former libraries of the American Institute of Mining

Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, and now has a total of 140 000 volumes and pamphlets. Containing, as the Library now does, the special collections mentioned, its scope is broadened, and, as it receives an unusually large number of technical periodicals, it is well equipped to continue the service formerly rendered by the Society Library.

The Engineering Societies Library offers this service at a cost which is trifling compared with the value of the time of an engineer who personally looks up such matters, and the work can be performed quite as well, and much more quickly, by persons familiar with the Library.

In asking that such work be undertaken, members should specify clearly the subject to be covered, and whether references to general books only are desired, or whether a complete bibliography, involving search through periodical literature, is desired.

It sometimes happens that references are found which are not readily accessible to the person for whom the search is made. In that case the Library is prepared to furnish photographic copies of the material at a small price per page. This method is particularly useful when there are drawings or figures in the text, which would be very expensive to reproduce by hand.

The Library is also able to provide translations of articles in foreign languages when desired.

**Requests for searches, copies, translations, etc., should be addressed to the Director, Engineering Societies Library, 29 West 39th Street, New York City, who will gladly give information concerning the charges for the various kinds of service.**

## LOCAL ASSOCIATIONS OF MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

### San Francisco Association, Organized 1905.

E. J. Schneider, President; Nathan A. Bowers, Secretary-Treasurer, 502 Rialto Building, San Francisco, Cal.

The San Francisco Association of Members of the American Society of Civil Engineers holds regular bi-monthly meetings, with banquet, and weekly informal luncheons. The former are held at 6 P. M., at the Engineers' Club, 57 Post Street, on the third Tuesday of February, April, June, August, October, and December, the last being the Annual Meeting of the Association.

Informal luncheons are held at noon, every Wednesday, at the Engineers' Club, where special tables are reserved for members and guests of the Association.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in San Francisco, and any such member will be gladly welcomed as a guest.

**Colorado Association, Organized 1908.**

L. R. Hinman, President; A. N. Miller, Secretary-Treasurer, 1400 West Colfax Avenue, Denver, Colo.

The meetings of the Colorado Association of Members of the American Society of Civil Engineers (Denver, Colo.) are held on the second Saturday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary. The meetings are usually preceded by an informal dinner. Members of the American Society of Civil Engineers will be welcomed at these meetings.

Weekly luncheons are held on Wednesday at 12.30 P. M., at Daniels and Fisher's.

Visiting members are urged to attend the meetings and luncheons.

(Abstract of Minutes of Meeting)

**December 21st, 1918.**—The meeting was called to order at the Denver Athletic Club; President L. R. Hinman in the chair; A. N. Miller, Secretary; and present, also 9 members and 1 guest.

The minutes of the meeting of November 16th, 1918, were read and approved.

The resolutions adopted by the Duluth Association, relative to the representation of the American Society of Civil Engineers at the Joint Engineering Congress in Paris, were read by the Secretary. On motion, duly seconded, it was decided that no action be taken on this matter until further and more definite information becomes available as to the manner of choosing the delegation.

The Committee on Legislation reported that the majority of the Committee was opposed to licensing civil engineers in Colorado. A minority report, signed by Messrs. Drager and Field, was also presented.

Mr. Thomas L. Wilkinson reported on the work of the Committee on Development at its Chicago meeting.

Owing to lack of time, Mr. Ridgway's address on "Unit Values for Transportation Service" was postponed.

Adjourned.

**Atlanta Association, Organized 1912.**

T. P. Branch, President; J. T. Wardlaw, Secretary-Treasurer, 1530 Healey Bldg., Atlanta, Ga.

Informal luncheons are held for members of the Association on the last Monday of each month, at 12.30 P. M. The place is not fixed, but this information will be furnished on application to the Secretary.

(Abstract of Minutes of Meeting)

**December 30th, 1918.**—The Annual Meeting was called to order in the Chamber of Commerce; President B. M. Hall in the chair; T. P. Branch, Secretary.

A communication from the Duluth Association relative to representation of the Society by members outside of New York City, was presented. On motion duly seconded, it was declared to be the sense of the meeting that the Atlanta Association joins with the Duluth Association in its protest that the membership outside of New York City

has been given practically no representation on the Joint Engineering Congress in Paris.

The following officers for the ensuing year were elected: President, T. P. Branch; Vice-President, V. H. Kriegshaber; Secretary-Treasurer, J. T. Wardlaw.

Plans for next year's activities were discussed.

On motion, duly seconded, it was declared to be the sense of the meeting that laws be enacted to compel the construction of fire-proof schools.

Adjourned.

**Baltimore Association, Organized 1914.**

H. G. Perring, President; Charles J. Tilden, Secretary-Treasurer, The Johns Hopkins University, Baltimore, Md.

**Cleveland Association, Organized 1914.**

F. D. Richards, President; George H. Tinker, Secretary-Treasurer, 516 Columbia Building, Cleveland, Ohio.

(Abstract of Minutes of Meeting)

**January 4th, 1919.**—The meeting was called to order at 12.30 P. M., in the rooms of the Cleveland Engineering Society; President Harry Fuller in the chair; George H. Tinker, Secretary; and present, also, 25 members.

The minutes of the meetings of July 13th and September 17th, 1918, were read and approved.

Messrs. Willard Beahan, James Ritchie, and E. W. Bowen were appointed by the President as a Nominating Committee to select a ticket for officers for 1919.

The report of the Secretary-Treasurer was read and approved.

The President commented briefly on the activities of the Association during the past year.

The Secretary announced the appointment by the President of Mr. E. B. Thomas as the Association's representative on the Committee on Development, and of Messrs. J. R. Poe and J. E. A. Moore as an Advisory Committee.

The Secretary announced that, as the result of a letter-ballot, Mr. F. C. Osborn had been recommended for appointment on the American Engineering Standards Committee.

The Secretary announced that the Pittsburgh Association desired the appointment of Mr. N. S. Sprague on the Nominating Committee to represent District No. 6.

The Secretary presented a communication from the Duluth Association containing resolutions in relation to the appointment by the Executive Committee of representatives of the Society at the Joint Engineering Congress in Paris, and, on motion, duly seconded, the meeting approved the action of the Duluth Association and ordered that that Association and the Executive Committee be so advised.

The Secretary was directed to invite Messrs. Talbot and Khuen to visit Cleveland and address the Association and the Cleveland Engineering Society.

Mr. E. B. Thomas reported on the work of the Committee on Development at its Chicago meeting, and this was followed by a discussion of the relations between the Association and the Cleveland Engineering Society. On motion, duly seconded, it was decided that a committee of three be appointed to confer with a similar committee from the Cleveland Engineering Society on closer relations between the two organizations.

The following officers were elected for 1919: President, F. D. Richards; Vice-President, W. P. Brown; Secretary-Treasurer, George H. Tinker.

Adjourned.

**Detroit Association, Organized 1916.**

T. A. Leisen, President; Clarence W. Hubbell, Secretary, 2348 Penobscot Building, Detroit, Mich.

The regular meetings of the Association are held on the second Friday of December, April, and October, the last being the Annual Meeting.

**District of Columbia Association, Organized 1916.**

A. P. Davis, President; John C. Hoyt, Secretary-Treasurer, U. S. Geological Survey, Washington, D. C.

(Abstract of Minutes of Meeting)

**December 30th, 1918.**—The Annual Meeting was called to order in the parlors of the Cosmos Club; President A. P. Davis in the chair; John C. Hoyt, Secretary; and present, also, 23 members.

The reports for the past year were presented.

The following officers were elected for the ensuing year: Arthur P. Davis, President; David S. Carll, Vice-President; John C. Hoyt, Secretary-Treasurer.

The work of the Society's Committee on Development was discussed by G. R. Putnam, the representative of the Association on that Committee, and others.

Adjourned.

**Duluth Association, Organized 1917.**

W. B. Patton, President; Walter G. Zimmermann, Secretary, Wolvin Building, Duluth, Minn.

The regular meetings of the Association are held at noon on the third Monday of each month (usually at the Kitchi Gammi Club), with luncheon, followed by a short business session and the reading of papers. Visiting members of the American Society of Civil Engineers can secure from the Secretary definite information relative to the meetings, at which they will be welcomed. The Annual Meeting is held on the third Monday in May.

(Abstract of Minutes of Meetings)

**December 16th, 1918.**—The meeting was called to order; President W. B. Patton in the chair; Walter G. Zimmermann, Secretary; and present, also, 21 members and 2 guests, Col. Francis A. Pope, U. S. A.,

the new Government Engineer for the Duluth District, and Mr. Morgan, of the American Society of Mechanical Engineers, both of whom addressed the meeting.

Mr. Lyonel Ayres read his memoir on the late Edward Porter Alexander, Jun. Am. Soc. C. E., who died in France.

Mr. Ash, Chairman of the Committee on Records, reported a recommendation that technical papers be limited to four subjects each year, the subjects to be assigned by the Programme Committee, and to be followed by discussions at the two following meetings after reading the paper. The recommendation was adopted.

The following resolutions, introduced by Mr. Hawley, were adopted unanimously:

"*Whereas:* An invitation has been extended by the French Society of Civil Engineers with the approval of the French Ministries of Public Works, of Commerce, and of Armament, to the American Society of Civil Engineers to send a delegation to a Joint Engineering Congress to be held in Paris in December for the purpose of discussing technical matters pertinent to reconstruction work and development of industry;

"*Whereas:* The Society has replied, accepting the invitation, and has invited the co-operation of the other National Societies of Mechanical, Electrical, and Mining Engineers;

"*Whereas:* At a special meeting of the Executive Committee held on November 22d, 1918, at which there were present Messrs. Kittredge, Alvord, Flinn, and C. W. Hunt, and Messrs. Lewis and A. M. Hunt of the Committee on Reconstruction Work, and Mr. Noble of the Committee on Development;

"*Whereas:* As a result of this meeting five New York City engineers and one Boston engineer have been chosen to represent the American Society of Civil Engineers, at the Joint Engineering Congress in Paris;

"*Resolved:* That the Duluth Association of Members of the American Society of Civil Engineers endorses the action of the Executive Committee in accepting the invitation and sending a delegation to above Congress;

"*Resolved:* That while the Duluth Association recognizes the peculiar fitness of the delegation selected, it is of the opinion that this delegation, composed of five New York City engineers and one Boston engineer, is not geographically representative of the American Society of Civil Engineers;

"*Resolved:* That the Duluth Association expresses its belief that the membership of the American Society outside of New York should have been represented by a larger number of members being selected for this delegation;

"*Resolved:* That the Duluth Association expresses its disapproval of all policies of the American Society of Civil Engineers which do not call for the active participation of the membership outside of New York City;

"*Resolved:* That copies of this Resolution be sent to the Executive Committee and the other Associations of Members."

The President introduced the question of the licensing of Engineers, now a current topic, stating that there was a possibility that it would come before the next meeting of the Minnesota Legislature. Mr. Hoyt stated that the matter was now being investigated by the Minnesota Joint Engineering Board, and might well be taken up by the Association, with a view to making recommendations, if it should come before the Legislature. On motion, duly seconded, the President was authorized to appoint a committee of three to make a thorough study of the subject, and to report at the next meeting. The President appointed Messrs. Reed, Clapper, and McCool to serve on this committee.

The President brought up the subject of the Engineering Societies of the country taking action in regard to post-bellum conditions, the employment of labor in the development of the country, and financial conditions with respect to public works. No action was taken.

Mr. Woodbury stated that he had been asked by the Secretary of Engineering Council to act as local Duluth correspondent with Engineering Council, that he had received many communications of interest to the Engineering Profession, and that he would be in favor of holding a special meeting at which this correspondence could be read and discussed. On motion, duly seconded, it was decided to hold a special meeting on Saturday, December 28th, 1918.

Owing to lack of time, the reading of a paper entitled "Hydraulic Lime and Its Uses in Concrete", by Mr. William E. Hawley, was postponed until January, that paper to be the first of the four papers for 1919.

Adjourned.

**December 28th, 1918. (Special Meeting.)**—The meeting was called to order at 8 P. M. at the Kitchi Gammi Club; President W. B. Patton in the chair; Walter G. Zimmermann, Secretary; and present, also, 15 members.

The Secretary presented letters from the Secretary of the Society in reference to the resolutions adopted at the meeting of December 16th, 1918.

The special meeting was called primarily for the purpose of presenting a number of letters from Secretary Flinn, of Engineering Council, in regard to the organization of engineers throughout the country. These letters were read by Mr. Woodbury and discussed by the meeting. The President appointed Messrs. Hawley and Lawrie as a committee to prepare resolutions covering certain points in a communication from Secretary Flinn, dated December 11th, 1918. This Committee submitted the following resolutions, and they were adopted unanimously:

*"Whereas:* It is highly desirable and very important to the membership of the four Founder Societies that said members be kept in touch with and advised of the information secured and progress made by Engineering Council in the projects to be presented for the information of said membership, in order that the members may be enabled to give proper consideration to the same, be it here

*"Resolved:* By the Duluth Association of Members of the American Society of Civil Engineers, that it recommends to Engineering

Council the adoption of some plan of sending a frequent bulletin or news circular to each of the members of the four Founder Societies as a means of transmitting such information, and be it further

*"Resolved:* By the Duluth Association that it will approve a temporary diversion of the funds of the societies from technical research and publication of the results thereof, if necessary, to finance such a news bulletin or news circular as suggested above, and let it be further

*"Resolved:* That a copy of the resolutions be sent to Engineering Council."

The following resolutions were adopted unanimously:

*"Whereas:* The meeting of the Committee on Development, to be convened in New York January 13th to 18th, has been postponed because of the expense entailed and because such meetings are said not to be favored in conjunction with the Annual Meeting of the Society; be it

*"Resolved:* That the Duluth Association of Members of the American Society of Civil Engineers considers the work to be performed by said Committee on Development to be paramount to any enterprise or undertaking in which the American Society of Civil Engineers is engaged; and be it

*"Resolved:* That the Board of Direction should 'especially authorize', in accordance with its resolution of May 5th, 1915, the Committee on Development to hold the proposed meeting in New York, January 13th to 18th, 1919, and be allowed mileage therefor; and be it further

*"Resolved:* That every facility and encouragement should be given the Committee on Development in its work; and be it further

*"Resolved:* That a copy of these resolutions be sent to the officials of the American Society of Civil Engineers, to all the members of the Committee on Development, and to all the Local Associations of Members of the American Society of Engineers."

The following resolutions were adopted unanimously:

*"Resolved:* That the Duluth Association of Members of the American Society of Civil Engineers has the highest confidence in its representative on the Committee on Development, Mr. W. H. Hoyt, and commends his efforts to serve his constituents and his progressive attitude on questions of reorganization as expressed in numerous letters and public utterances; and be it

*"Resolved:* That this Association is heartily in favor of direct responsible representation being made a cardinal principle in the proposed reorganization; and

*"Resolved:* That these resolutions be placed in the minutes of this Association and a copy be presented to Mr. Hoyt."

The President appointed Messrs. Pickles and Zimmermann as a committee to draw up and forward to the Board of Direction a letter calling attention to the map in the 1918 Year Book, with a request that this map be corrected and brought up to date before publication in the 1919 Year Book, and that the City of Duluth be shown thereon.

On motion, duly seconded, the Secretary was instructed to obtain the consent of other Local Associations to the exchange of copies of all resolutions of general interest which are being addressed to the Parent Society.

Mr. Hoyt reported on a number of points now being studied by the Committee on Development, and these matters were discussed.

Adjourned.

**January 27th, 1919.**—The meeting was called to order at noon, at the Kitchi Gammi Club; President W. B. Patton in the chair; Walter G. Zimmermann, Secretary; and present, also, 21 members.

The minutes of the meeting of December 28th, 1918, were read and approved.

The Secretary presented a letter from Mr. E. T. Howson, Secretary of the Committee on Development, requesting certain data regarding each of the Local Associations. The Secretary was instructed to furnish the information as promptly as possible.

The Secretary presented a letter from Mr. W. N. Jones, Secretary of the Northwestern Association, in reference to the Annual Convention. It was decided that the Secretary be instructed to express to the Northwestern Association the willingness of the Duluth Association to use its influence to secure the Convention for the "Twin Cities" and Duluth, along the same lines as worked out for the 1917 Convention, which was later postponed on account of the War, and that the same Committees, Messrs. House and Hoyt, on securing the Convention, and Messrs. Stack, Lewis, and Pickles, on local entertainment programme, be requested to serve and carry out the necessary arrangements.

The Secretary presented a letter from the Secretary of Engineering Council, dated January 8th, 1919, pertaining to the resolutions adopted by the Association, covering the matter of informing the Local Associations about the work of Engineering Council.

The Secretary presented a number of letters from Local Associations, approving the resolutions adopted by the Association pertaining to the appointment of five Engineers from New York and one from Boston as a representative delegation to the Paris Engineering Congress.

The Secretary presented several letters from Engineering Council, the Committee on Development, and Local Associations, relative to the postponement of the meeting of the Committee on Development at the time of the Annual Meeting of the Society.

The Committee appointed to prepare a memoir of the late Clarence Coleman, M. Am. Soc. C. E., submitted the memoir, and the Secretary was instructed to file it and forward a copy to the Society for publication.

Mr. Hoyt, who had attended the Annual Meeting of the Society, reported on his observations at that meeting.

Mr. Woodbury reported on his attendance at the meeting of the Illinois Association, and read a letter from the American Society of Mechanical Engineers in reference to the "Pan American Engineering Organization".

Messrs. Coe and Bryan were asked to prepare short talks on their army experience for the next meeting.

Adjourned.

**Illinois Association, Organized 1916.**

H. J. Burt, President; Edgar S. Nethercut, Secretary-Treasurer, 1735 Monadnock Blk., Chicago, Ill.

The regular meetings of the Association are held on the second Monday of March, June, September, and December, the last being the Annual Meeting. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

**Louisiana Association, Organized 1914.**

Arsène Perrilliat, President; Eugene F. Delery, Secretary, 2007 Laharpe Street, New Orleans, La.

The regular meetings of the Association are held at The Cabildo, New Orleans, La., on the first Monday of January, April, July, and October.

**Nebraska Association, Organized 1917.**

Adna Dobson, President; Homer V. Knouse, Secretary-Treasurer, 109 City Hall, Omaha, Nebr.

Regular meetings of the Association are held on the first Saturday of each month, except July and August, and at such places as may be appointed from time to time by the Executive Committee. The Annual Meeting is held in Lincoln, Nebr., on the second Friday in January.

Visiting members of the Society are especially urged to communicate with the Secretary when in the city.

(Abstract of Minutes of Meeting)

**January 4th, 1919.**—The Annual Meeting was called to order, at the Lincoln Hotel, Lincoln, Nebr.; President Campen in the chair; Homer V. Knouse, Secretary; and present, also, 17 members and guests.

The minutes of the meeting of December 7th, 1918, were read and approved.

The Secretary presented a number of communications.

Messrs. Grant and Hershey were appointed Tellers to canvass the ballots for officers for 1919, and, on the presentation of their report, the President announced the following elections: President, Adna Dobson; Senior Vice-President, John A. Bruce; Junior Vice-President, A. C. Arend; Secretary-Treasurer, Homer V. Knouse.

Due to illness, President-elect Dobson was not present, and, on his behalf, a message of appreciation and greeting was conveyed to the Association by Mr. Campen.

Vice-President Bruce made a short address, mentioning the lines to which the activities of the Association should be devoted during the coming year, and urging a still greater degree of co-operation on the part of each member.

The Preliminary Report of the Committee on Development was discussed, and the following resolution adopted:

"*Resolved,* That this Association believes that Courts should be permitted (or required) to appoint one or more engineers to advise

them regarding engineering matters, and that the engineer or engineering commission so appointed may be instructed to act as Masters, or make independent investigations and submit written reports for the information of the Court."

Mr. Grant, Chairman of the Legislative Committee, reported orally on matters which should come before the next session of the Legislature.

The Legislative Committee was instructed to prepare, and introduce at the present session of the Nebraska Legislature, an Engineers' License Law, after a study of the bill prepared by the Parent Society and laws in effect or under consideration in other States; also to introduce a bill to increase the annual salary of the State Engineer to $5 000, and of the Engineer of the State Board of Health to $3 000.

On motion, duly seconded, the retiring President was instructed to appoint a Legislative Committee, subject to the approval of the President-elect. The following were appointed: Mr. William Grant, Chairman, and Messrs. A. S. Mirick, A. H. Edgren, John A. Bruce, C. Louis Meyer, John L. Hershey, and W. F. Day.

On motion, duly seconded, the retiring President was instructed to appoint a Programme Committee, subject to the approval of the President-elect. The following were appointed: Mr. William Grant, Chairman, and Messrs. R. H. Findley and Karl E. Vogel.

On motion, duly seconded, the Secretary-Treasurer was instructed to levy a special assessment of $2 per member for the year 1919.

Mr. Clark E. Mickey presented a report advising that the Regents of the State University would probably authorize a short course in Highway Engineering during the coming year, to be followed by a Highway Institute for County Commissioners and others interested.

Adjourned.

**Northwestern Association, Organized 1914.**

Ralph D. Thomas, President; W. N. Jones, Secretary, City Engineer's Office, City Hall, Minneapolis, Minn.

The meetings of the Association are held bi-monthly, alternating between St. Paul and Minneapolis, on the third Friday of each month. Information as to the time and place of such meetings will be furnished on application to the Secretary.

**Philadelphia Association, Organized 1913.**

F. Herbert Snow, President; Henry T. Shelley, Secretary, 416 City Hall, Philadelphia, Pa.

The regular meetings of the Association are held at the Engineers' Club of Philadelphia, 1317 Spruce Street, on the first Monday in January, April, and October, the last being the Annual Meeting.

(Abstract of Minutes of Meeting)

**January 6th, 1919.**—A meeting of the Board of Directors was called to order at 5.30 P. M., at the Union League Club; President Snow in the chair; H. T. Shelley, Secretary; and present, also, Messrs. S. T. Wagner, W. L. Stevenson, and John Meigs.

On motion, duly seconded, Mr. Fred C. Dunlap was elected to fill the vacancy on the Board of Directors, caused by the election of Mr. Shelley as Secretary.

On motion, duly seconded, the Board of Directors authorized the appointment of a Committee on Meetings, such Committee to have not more than five members, one of whom is to be the Secretary of the Association.

On motion, duly seconded, the appointment of a Committee on Membership was authorized, to be composed of not less than five nor more than fifteen members, including the Secretary of the Association.

On motion, duly seconded, the appointment of a Committee on Publications was authorized, this Committee to have not more than five members and to include the Secretary.

On motion, duly seconded, the Board authorized the appointment of a Committee to review papers read before the Association, and to make recommendations as to what portions of such papers should be made the subject of discussion by the Association.

Adjourned.

**Pittsburgh Association, Organized 1917.**

Robert A. Cummings, President; Nathan Schein, Secretary-Treasurer, 1510 Carson Street, Pittsburgh, Pa.

The Annual Meeting of the Association is held on the first Monday in October. The time and place of other meetings are not fixed, but this information will be furnished on application to the Secretary.

**Portland, Ore., Association, Organized 1913.**

E. Burslem Thomson, President; C. P. Keyser, Secretary, 318 City Hall, Portland, Ore.

**St. Louis Association, Organized 1888 (Constitution Approved by Board, 1914).**

J. A. Ockerson, President; C. W. S. Sammelman, Secretary-Treasurer, 300 City Hall, St. Louis, Mo.

The Annual Meeting of the Association, for the election of officers and for the transaction of business, is held on the fourth Monday in November. Two meetings each year, for the presentation and discussion of technical papers, are held in the Auditorium of the Engineers Club of St. Louis and are open to members of the Associated Societies. Other "get-together" meetings are held regularly for dinner or luncheon on the fourth Monday of each month except July, August, and November.

(Abstract of Minutes of Meeting)

**November 25th, 1918.**—The Annual Meeting was called to order at 7.45 P. M.; President J. A. Ockerson in the chair; Baxter L. Brown acting as Secretary; and present, also, 9 members.

The minutes of the previous meeting were read and approved.

The annual reports of the Secretary and of the Treasurer were read and approved.

The following officers were elected for the ensuing year: President, J. A. Ockerson; Vice-President, J. W. Woermann; Secretary-Treasurer, C. W. S. Sammelmann; Councilors, J. W. Woermann and W. E. Rolfe.

Mr. Baxter L. Brown reported on the work of the Committee on Development at its Chicago meeting.

Professor Charles E. Galt, of Washington University, presented an interesting analysis of Dr. Charles R. Mann's Report on Engineering Education, and the subject was discussed by Messrs. Woermann, Brown, Gifford, and Ockerson.

A vote of thanks was tendered to Mr. C. M. Daily, the outgoing Secretary, for the efficient manner in which he conducted the office, and as an appreciation of his efforts in behalf of the Association.

On motion, duly seconded, the Secretary was instructed to mail a questionnaire to all members of the Association for the purpose of developing local interest in the Society.

On motion, duly seconded, the dues for the ensuing year were fixed at $2 per member.

Adjourned.

**San Diego Association, Organized 1915.**

W. C. Earle, President; Ralph Wueste, Secretary-Treasurer, Bonita, Cal.

**Seattle Association, Organized 1913.**

A. S. Downey, President; Phil A. Franklin, Secretary, 1409 East 65th St., Seattle, Wash.

The regular monthly meetings and luncheons of the Association are held at the Frye Hotel, 3d Avenue and Yesler Way, at 12.15 P. M., on the last Monday of each month. All members, in any grade, of the American Society of Civil Engineers are cordially invited to attend the meetings when in the vicinity.

**Southern California Association, Organized 1914.**

George G. Anderson, President; Floyd G. Dessery, Secretary, 511 Central Building, Los Angeles, Cal.

The Southern California Association of Members of the American Society of Civil Engineers (Los Angeles, Cal.) holds regular bi-monthly meetings on the second Wednesday of February, April, June, August, October, and December, the last being the Annual Meeting.

Informal luncheons are held at 12.15 P. M., every Thursday, and the place of meeting may be ascertained from the Secretary.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in Los Angeles, and any such member will be gladly welcomed as a guest at any of the meetings or luncheons.

**Spokane Association, Organized 1914.**

Peter Mogensen, President; Charles E. Davis, Secretary, City Engineer's Office, Spokane, Wash.

The regular meetings of the Association are held on the second Friday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

Visiting members are invited to attend the meetings.

**Texas Association, Organized 1913.**

R. J. Potts, President; J. H. Brillhart, Secretary, Care, Mosher Mfg. Co., Dallas, Tex.

(Abstract of Minutes of Meetings)

**December 13th, 1918.**—The meeting was called to order at the University Club, Dallas, Tex.; Vice-President R. J. Potts in the chair; J. H. Brillhart, Secretary; and present, also, 21 members.

The minutes of the previous meeting were read.

The report of the Legislative Committee was received.

The report of the Secretary-Treasurer for 1918, showing receipts, $187.73, and disbursements, $172.29, and a cash balance of $15.44, was received.

J. H. Brillhart, the Association's representative on the Committee on Development, reported on the Chicago meeting of that Committee, and the following matters were discussed: Technical Activities and Standards in Engineering Practice, by O. H. Lang; and Internal Relations and Local Associations, including Co-operation of Sub-committees of Local Associations with National Societies, by Messrs. J. C. Nable and C. H. Chamberlin.

The Secretary read a telegram from President R. C. Gowdy, regretting that illness prevented him from attending the meeting, and C. H. Chamberlin was appointed as a committee to reply.

Adjourned.

**December 14th, 1918.**—The meeting was called to order at 2 P. M. at the University Club.

The following Committee on Resolutions was appointed: J. M. Howe, Chairman, C. H. Chamberlin, and C. M. Davis.

The following subdivisions of the Report of the Committee on Development were discussed:

*II.—Internal Relations and Local Associations.*

1.—Local Associations, by C. M. Davis.

3.—Re-arrangement of the Grades of Membership, by R. L. Morrison.

4.—Student Engineers, by R. L. Morrison.

5.—Young Men of the Profession, by J. C. Nagle.

6.—Personal Service Bureau, by C. H. Chamberlin.

*III.—External Relations with the Engineering Profession.*

3.—Amalgamation of Engineering Societies, by Messrs. R. L. Holmes and C. M. Davis.

4.—American Engineers in Foreign Service, by Messrs. R. L. Morrison and E. C. Connor.

*IV.—Relations to Public Affairs.*

1.—Professional Status of the Engineer.

*a.*—Definition of the Engineer, by R. J. Potts.

*b.*—Education of the Engineer, by R. J. Potts.

*c.*—Professional Ethics, by C. T. Bartlett.

*d.*—Service of the Engineer to the Nation, the State, and the Community, by J. F. Witt.

2.—Legal Status of the Engineer.
*a.*—Licensing, by J. M. Howe.
*b.*—Legislation and Patent Laws, by C. T. Bartlett.
*c.*—Arbitration and Expert Testimony, by Messrs. R. M. Dunham and W. E. Beilharz.
3.—Public Status of the Engineer.
*a.*—Publicity, by E. R. Chamblin.
*b.*—Public and Industrial Affairs, by O. H. Lang.
*c.*—Development of Natural Resources, by E. R. Chamblin.
*d.*—Co-ordination of Government Engineering Activities, by Messrs. C. M. Davis and R. M. Dunham.

The Committee on Resolutions reported a set of resolutions to be forwarded to the Committee on Development. On motion, duly seconded, these resolutions were adopted.

The following officers were elected: R. J. Potts, President; Hans Helland, First Vice-President; C. M. Davis, Second Vice-President; J. H. Brillhart, Secretary-Treasurer.

On motion, duly seconded, the action of the Association, taken at Dallas, in reference to the permanent headquarters of the Society, was rescinded, and the matter left in the hands of the Board of Direction.

On motion, duly seconded, the Secretary was instructed to extend a vote of thanks to the *News* and *Journal* and the press for the publicity given to the Association, to the University Club for the use of its rooms, and to the local members for their hospitality.

E. R. Chamblin was appointed a Committee on Necrology, and reported the following resolutions in reference to the late Robert Earle Shipley, Assoc. M. Am. Soc. C. E.:

"*Whereas,* Our esteemed friend and brother engineer, Robert E. Shipley, has been called from this life, while in the service of his country; and

"*Whereas,* A great loss has been sustained thereby, by the Engineering Profession and by each individual member of the American Society of Civil Engineers; be it

"*Resolved,* That the Texas Association of Members of the American Society of Civil Engineers, assembled in Annual Meeting at Dallas, December 14th, 1918, expresses its high regard for his character, professional attainments and accomplishments, and his self-sacrificing spirit of patriotism; and be it further

"*Resolved,* That these resolutions be spread upon the minutes, and that a copy be sent to his family".

Eleven candidates were elected to membership in the Association.

Adjourned.

**Utah Association, Organized 1916.**

A. B. Villadsen, President, 304 Dooly Block, Salt Lake City, Utah.

The Annual Meeting of the Association is held on the first Wednesday in April. The time of other meetings is not fixed, but this information will be furnished on application to the President.

## MINUTES OF MEETINGS OF SPECIAL COMMITTEES TO REPORT UPON ENGINEERING SUBJECTS

### Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, etc.

**January 14th, 1919.**—The meeting was called to order at Society Headquarters. Present, Robert G. Cummings (Chairman), Allen Hazen, J. C. Meem, and E. G. Haines (Secretary *pro tem.*)

The question of submitting a report for 1919 was discussed, and it was decided to submit a very brief statement of facts as to progress and intentions for the coming year.

The Chairman agreed to prepare a brief summary of the operations and conclusions to date, covering the classification of soils, methods of conducting tests, etc., and to submit it to the other members for approval or discussion.

Mr. Hazen agreed to present a statement of his experience with certain classes of soil resembling clays, and also suggestions as to methods of tests to determine specific gravity, voids, etc., in clays.

Mr. Meem agreed to furnish a statement of certain experiences as to compression of soils as developed in underpinning operations, etc.

The tentative plans for field testing apparatus for determining the bearing value of soils, as presented by Mr. Haines, were discussed and their general features approved.

Adjourned, subject to the call of the Chairman.

## PRIVILEGES OF ENGINEERING SOCIETIES EXTENDED TO MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Members of the American Society of Civil Engineers will be welcomed by the following Engineering Societies, both to the use of their Reading Rooms, and at all meetings:

**American Institute of Electrical Engineers,** 25 West Thirty-ninth Street, New York City.

**American Institute of Mining Engineers,** 25 West Thirty-ninth Street, New York City.

**American Society of Mechanical Engineers,** 25 West Thirty-ninth Street, New York City.

**Asociación de Ingenieros y Arquitectos de Mexico,** Avenida Juarez, 12, City of Mexico, Mexico.

**Assoçiacão dos Engenheiros Civis Portuguezes,** Lisbon, Portugal.

**Australasian Institute of Mining Engineers,** Melbourne, Victoria, Australia.

**Boston Society of Civil Engineers,** 715 Tremont Temple, Boston, Mass.

**Brooklyn Engineers' Club,** 117 Remsen Street, Brooklyn, N. Y.

**Civil Engineers' Society of St. Paul,** Public Library, St. Paul, Minn.

**Cleveland Engineering Society,** Chamber of Commerce Building, Cleveland, Ohio.

**Cleveland Institute of Engineers,** Middlesbrough, England.

**Dansk Ingeniorforening,** Amaliegade 38, Copenhagen, Denmark.

**Detroit Engineering Society,** Detroit Board of Commerce Building, Detroit, Mich.

**Engineering Association of Nashville,** Commercial Club Building, Nashville, Tenn.

**Engineering Association of New South Wales,** 5 Elizabeth Street, Sydney, New South Wales, Australia.

**Engineering Institute of Canada,** 176 Mansfield Street, Montreal, Que., Canada.

**Engineering Societies Club of Hawaii,** E. F. Cykler, Secretary, Honolulu, Hawaii.

**Engineers and Architects Association of Southern California,** 405 Hosfield Bldg., Los Angeles, Cal.

**Engineers and Architects Club of Louisville,** 1412 Starks Building, Louisville, Ky.

**Engineers' Club of Baltimore,** 6 West Eager Street, Baltimore, Md.

**Engineers' Club of Kansas City,** Robert S. Beard, Secretary, Third Floor, City Hall, Kansas City, Mo.

**Engineers' Club of Minneapolis,** 17 South Sixth Street, Minneapolis, Minn.

**Engineers' Club of Philadelphia,** 1317 Spruce Street, Philadelphia, Pa.

**Engineers' Club of St. Louis,** 3817 Olive Street, St. Louis, Mo.

**Engineers' Club of Toronto,** 96 King Street, West, Toronto, Ont., Canada.

**Engineers' Club of Trenton,** Trent Theatre Building, 12 North Warren Street, Trenton, N. J.

**Engineers' Society of Northeastern Pennsylvania,** 415 Washington Avenue, Scranton, Pa.

**Engineers' Society of Pennsylvania,** 31 South Front Street, Harrisburg, Pa.

**Engineers' Society of Western Pennsylvania,** 568 Union Arcade Building, Pittsburgh, Pa.

**Florida Engineering Society,** J. R. Benton, Secretary, Gainesville, Fla.

**Institute of Marine Engineers,** The Minories, Tower Hill, London, E., England.

**Institution of Civil Engineers,** Great George Street, Westminster, S. W., London, England.

**Institution of Engineers of the River Plate,** Calle 25 de Mayo 195, Buenos Aires, Argentine Republic.

**Institution of Mechanical Engineers,** 11 Great George Street, London, S. W. 1, England.

**Institution of Naval Architects,** 5 Adelphi Terrace, London, W. C., England.

**Junior Institution of Engineers,** 39 Victoria Street, Westminster, S. W., London, England.

**Koninklijk Instituut van Ingenieurs,** The Hague, The Netherlands.

**Louisiana Engineering Society,** State Museum Building, Chartres and St. Ann Streets, New Orleans, La.

**Memphis Engineers' Club,** Memphis, Tenn.

**Midland Institute of Mining, Civil and Mechanical Engineers,** Sheffield, England.

**Montana Society of Engineers,** Butte, Mont.

**North of England Institute of Mining and Mechanical Engineers,** Newcastle-upon-Tyne, England.

**Oregon Society of Civil Engineers,** Portland, Ore.

**Pacific Northwest Society of Engineers,** 803 Central Building, Seattle, Wash.

**Rochester Engineering Society,** Rochester, N. Y.

**Sociedad Colombiana de Ingenieros,** Bogota, Colombia.

**Sociedad de Ingenieros del Peru,** Lima, Peru.

**Societe des Ingenieurs Civils de France,** 19 rue Blanche, Paris, France.

**Society of Engineers,** 17 Victoria Street, Westminster, S. W., London, England.

**Southwestern Society of Engineers,** C. E. Barglebaugh, Secretary, 703 First National Bank Building, El Paso, Tex.

**Svenska Teknologforeningen,** Brunkebergstorg 18, Stockholm, Sweden.

**Tekniske Forening,** Vestre Boulevard 18–1, Copenhagen, Denmark.

**Vermont Society of Engineers,** George A. Reed, Secretary, Montpelier, Vt.

**Western Society of Engineers,** 1735 Monadnock Block, Chicago, Ill.

# ACCESSIONS TO THE ENGINEERING SOCIETIES LIBRARY

(From January 1st to January 31st, 1919)

## DONATIONS*

**The statements made in these notices are taken from the books themselves, and this Society is not responsible for them.**

THE THEORY OF ELECTRICITY:

By G. H. Livens. Cambridge, England, The University Press, 1918. 717 pp., 11 x 7 in., cloth. $8.25. (Gift of G. P. Putnam's Sons.)

Dissatisfaction with the treatment of this subject in standard textbooks, which the author believes to be incomplete, often unconvincing, and sometimes erroneous, leads him to offer this work as a general textbook on the mathematical aspects of modern electrical theory in which an attempt is made to present the complete subject in a consistent form. Although his exposition is essentially a mathematical one, much of the purely analytical mathematics generally associated with the subject has been omitted. Particular attention, however, has been given to the rigorous formulation of underlying physical principles and to their translation into a mathematical theory. The dynamical aspects of the subject have been specially emphasized throughout.

CLASSROOM LECTURE NOTES:

Automotive Starting, Lighting and Ignition. By R. C. Fryer. 2d ed. N. Y., John Wiley and Sons, Inc.; Lond., Chapman and Hall, Ltd., 1918. 210 pp., diag., 8 x 5 in., cloth. $1.25.

The author provides a general, concise series of notes, including the essential knowledge needed by the student, but requiring enlargement by the instructor. Eighty-eight pages of wiring diagrams are given.

STEAM ENGINES;

Prepared in the Extension Division of the University of Wisconsin, by E. M. Shealy. (Engineering Education Series.) N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 290 pp., 173 illus., 9 x 6 in., cloth. $2.50.

This is the third of a series of three textbooks on steam engineering, prepared for correspondence students in the University of Wisconsin Extension Division. The aim in this volume is to teach the fundamental principles underlying the operation of the steam engine, in as simple and non-mathematical a manner as possible. Particular attention is given to valve gears.

MAKING THE SMALL SHOP PROFITABLE:

By John H. Van Deventer. N. Y., The American Machinist (McGraw-Hill Book Co., Sole Selling Agents), 1918. 113 pp., illus., 12 x 9 in., ¼ cloth. $1.75.

This book contains a series of articles on important phases of the activities of small machine shops, proper methods of working, cost-keeping, etc., and also illustrations of many handy devices for facilitating work, particularly in shops with limited equipment. It is a continuation of the author's "Success in the Small Shop." The articles first appeared in the *American Machinist*.

CHILTON TRACTOR INDEX;

Published Semi-Annually by the Chilton Co., Phila., Jan., 1919. 464 pp., 10 x 7 in., paper. $1.00.

The Tractor Index is a directory of the manufacturers of tractors, tractor parts and accessories, and power farming machinery in the United States. It also in-

*Unless otherwise specified, books in this list have been donated by the publishers.

cludes an illustrated list of American tractors, in which brief specifications for each tractor are given, a table of complete specifications for 198 tractors, and a similar table of specifications for power farm machinery. A collection of articles on tractors and farm machinery completes the work.

**THE FUNDAMENTAL EQUATIONS OF DYNAMICS,**

And Its Main Co-ordinate Systems Vectorially Treated and Illustrated from Rigid Dynamics. By Frederick Slate. Berkeley, University of California Press, 1918. 233 pp., 8 x 6 in., cloth. $2.00.

The author of this volume feels that the extensiveness of the field of dynamics has necessitated such compression in the general surveys of its principles that the usual treatment leans too heavily on mathematics. His desire has been to prepare a supplement to such standard works, which will direct attention to the physical aspects, and to experimental reasoning, by offering a flexible continuation of an elementary stage with unsettled achievement. The book forms Part Two of "Principles of Mechanics."

**PRACTICAL OIL GEOLOGY:**

The Application of Geology to Oil Field Problems. By Dorsey Hager. 3d ed. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Pub. Co., Ltd., 1919. 253 pp., 126 illus., 37 tab., 7 x 5 in., flexible cloth. $2.50.

The author of this handbook has aimed to provide a clear, concise, and practical work on the occurrence of oil and its geology, based on American practice. The present edition, the third in four years, has been thoroughly revised, enlarged, and reset.

**A HANDBOOK OF PHYSICS MEASUREMENTS:**

Vol. I, Fundamental Measurements, Properties of Matter, and Optics; Vol. II, Vibratory Motion, Sound, Heat, Electricity and Magnetism. By Ervin S. Ferry, in Collaboration with O. W. Silvey, G. W. Sherman, Jr., and D. C. Duncan. N. Y., John Wiley and Sons, Inc.; Lond., Chapman and Hall, Ltd., 1918. 251 + 233 pp., illus., tab., 8 x 5 in., cloth. $2 per volume.

The aim of this work is to furnish the student of pure or applied science with a self-contained manual of the theory and manipulation of those measurements in physics which bear most directly on his subsequent work in other departments of study and on his future professional career. The experiments have been selected with regard to the particular determinations now demanded by science and industry and so grouped as to segregate those of value for students of the various branches of engineering.

**AMERICAN METHODS IN FOREIGN TRADE:**

A Guide to Export Selling Policy. By George C. Vedder. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 204 pp., 8 x 6 in., cloth. $2.00.

The author of this volume is a believer in the soundness of the distinctively American methods of developing an export trade which hitherto have been adopted by the most efficient world traders. He attempts, in this volume, to explain how these firms have achieved success and to outline the proper policy to be adopted by those interested in entering foreign markets.

**THE SILK DIRECTORY:**

Davison's Silk Trade; A Directory of the Silk Manufacturers of the United States and Canada, Including Silk Dyers, Finishers, and Printers, Manufacturers' Agents, City Offices and Salesrooms of Silk Mills, Dealers in Raw, Thrown, Spun, and Artificial Silk, Waste, Cotton, Tinsel and Worsted Yarns, Silk Jobbers and Retailers, and a

Classified Directory of All Manufacturers of Silk Goods. 23d annual edition, 1918. N. Y., Davison Publishing Co. (copyright 1918). 778 pp., 8 x 6 in., cloth. $3.50.

The directory includes dyers, finishers, printers, manufacturers' agents, city offices and salesrooms of mills, dealers, jobbers, retailers, and manufacturers. These are given in lists classified primarily by occupation and secondarily by location. The lists have been carefully revised and enlarged by the addition of new establishments.

AMERICAN HIGHWAY ENGINEERS' HANDBOOK.

Arthur H. Blanchard, Editor-in-Chief. N. Y., John Wiley and Sons, Inc.; Lond., Chapman and Hall, Ltd., 1919. 1658 pp., illus., tab., 7 x 4 in., flexible cloth. $5.00.

The task undertaken has been the compilation of a reference book which would give reliable and comprehensive information on all branches of highway engineering and related subjects, including organization and administration of highway departments, financing of improvements, highway design, paving, testing, costs, etc. These questions are discussed in twenty-nine sections, each of which has been edited by an authority. Bibliographies for each section and an extensive index have been provided.

CHLORINATION OF WATER.

By Joseph Race. N. Y., John Wiley and Sons, Inc., 1918. 158 pp., 8 x 5 in., cloth. $1.50.

The author has collected and correlated the scattered information in print on the purification of water by chlorine, and presents a systematic account of the theory, practical application, and results. Numerous references to the original publications are given. Contents: Historical; Modus Operandi; Dosage; Bacteria Surviving Chlorination; Complaints; Bleach Treatment; Liquid Chlorine; Electrolytic Chlorine and Hypochlorites; Chloramine; Results Obtained; Appendix.

# SUMMARY OF SOCIETY MEMBERSHIP SERVING IN THE ARMIES AND NAVIES OF THE UNITED STATES AND ITS ALLIES

February 11th, 1919

| AMERICAN ARMY | |
|---|---|
| Major-General | 9 |
| Brig.-Generals | 18 |
| Colonels | 52 |
| Lt.-Colonels | 59 |
| Majors | 249 |
| Captains | 534 |
| First Lieutenants | 252 |
| Second Lieutenants | 65 |
| Regimental Sergeants | 1 |
| Master Engineers | 8 |
| Master Gunners | 2 |
| Sergeants | 16 |
| Corporals | 10 |
| Privates | 35 |
| Students, Training Camps | 6 |
| Miscellaneous | 4 |
| Total | 1320 |

| BRITISH ARMY | |
|---|---|
| Brig.-Generals | 1 |
| Lt.-Colonels | 5 |
| Majors | 10 |
| Captains | 17 |
| Lieutenants | 14 |
| Second Lieutenants | 6 |
| Corporals | 2 |
| Privates | 1 |
| Miscellaneous | 1 |
| Total | 57 |

| FRENCH ARMY | |
|---|---|
| Commandant | 1 |
| Captains | 1 |
| Sous-Lieutenant | 1 |
| Aspirant | 1 |
| Miscellaneous | 2 |
| Total | 6 |

| ITALIAN ARMY | |
|---|---|
| Colonel | 1 |
| Total in Armies | 1384 |

| SUMMARY FOR ARMIES | |
|---|---|
| Major-Generals | 9 |
| Brig.-Generals | 19 |
| Colonels | 53 |
| Lt.-Colonels | 64 |
| Majors | 259 |
| Commandant | 1 |
| Captains | 552 |
| Lieutenants | 266 |
| Second Lieutenants | 72 |
| Regimental Sergeants | 1 |
| Master Engineers | 8 |
| Master Gunners | 2 |
| Sergeants | 16 |
| Corporals | 12 |
| Privates | 36 |
| Students, Training Camps | 7 |
| Miscellaneous | 7 |
| Total | 1384 |

| AMERICAN NAVY | |
|---|---|
| Rear-Admirals | 5 |
| Captains | 6 |
| Commanders | 14 |
| Lt.-Commanders | 13 |
| Civil Engineers (rank not given) | 9 |
| Lieutenants | 27 |
| Lieutenants (Junior Grade) | 12 |
| Ensigns | 10 |
| Asst. Paymaster (rank not given) | 1 |
| Chf. Machinist's Mate | 2 |
| Chf. Carpenter's Mate | 1 |
| Total in Navy | 100 |

## RECAPITULATION

| | | |
|---|---|---|
| Total in Armies | 1384 | |
| Total in Navy | 100 | |
| Total on Roll of Honor | | 1484 |
| Died in Service | | 22 |
| Grand Total | | 1506 |

## ROLL OF HONOR

**A List of Members of the Society Who are Serving in the Army or Navy of the United States or Any of Its Allies.***

***VANSITTART, GEORGE EDWARD.*** *Maj., 13th Battery, Canadian Field Artillery, 2d Canadian Div.; wounded in action (France); died May 14th, 1916.*

***AGNEW, AUGUSTUS WATEROUS.*** *Capt., 3d Canadian Pioneers; wounded in action (France); died September 17th, 1916.*

***HAGUE, WILLIAM.*** *1st Lieut., Engr. R. C., 116th Engrs.; died in service (France), January 1st, 1918.*

***GOODFELLOW, JAMES GORDON.*** *Maj., Royal Engrs.; killed in action (France), March 23d, 1918.*

***BUCKWALTER, HARRIS DANIEL.*** *Capt., Engr. R. C.; killed in action (France), May 12th, 1918.*

***LINDBERY, CHARLES ARTHUR.*** *Capt., Engr. R. C.; died in service (Camp Lee, Va.), May 27th, 1918.*

***ANNEAR, EDGAR HAROLD.*** *Capt., Engr. R. C.; died in service (Hoboken, N. J.), August 28th, 1918.*

***SLEPPY, KIRBY BALDWIN.*** *Capt., Engineers, U. S. A., 4th Engrs.; killed in action (France), August 4th, 1918.*

***ALEXANDER, EDWARD PORTER.*** *1st Lieut., Engineers, U. S. A., 509th Engrs.; died in service (France), September 5th, 1918.*

***McCLURE, HUNTER.*** *1st Lieut., Engineers, U. S. A., Co. N, 21st Engrs.; died in service (France), September 26th, 1918.*

***REAM, WARD HALL.*** *1st Lieut., Engineers, U. S. A., Co. C, 305th Engrs.; killed in action (France), October 4th, 1918.*

***DEDICKE, ERNEST CHARLES.*** *1st Lieut., U. S. A.; wounded in action (France); died July 15th, 1918.*

***DEAN, STANLEY.*** *Capt., Quartermaster Corps, U. S. A.; died in service (Camp Humphreys, Va.), October 2d, 1918.*

***PECK, MYRON HALL.*** *Capt., Engineers, U. S. A., 2d Engrs.; killed in action (France), October 9th, 1918.*

***HONEYMAN, BRUCE RITCHIE.*** *Capt., Engineers, U. S. A., Co. A, 313th Engrs.; died in service (France), October 15th, 1918.*

***MILLS, ADELBERT PHILO.*** *Capt., Engineers, U. S. A.; died in service (France), October 20th, 1918.*

***PRITCHETT, FREDERIC BORRADAILE.*** *Lieut., 109th F. A., Headquarters Co., 28th Div.; wounded in action (France); died September 6th, 1918.*

***MURRAY, JAMES POWELL.*** *Capt., Engineers, U. S. A.; died in service (Austin, Tex.), September 28th, 1918.*

***JONES, GRANDVILLE REYNARD.*** *Capt., Sanitary Corps, U. S. A.; died in service (Camp Benning, Ga.), December 22d, 1918.*

* This list is made up from replies to a circular forwarded to members of the Society, and others, and is probably neither accurate nor complete. It is requested that the attention of the Secretary be called to any omissions or inaccuracies in order that they may be corrected in subsequent lists.

*BELL, VICTOR HUGO.* *M. S. E., Meteorological Detachment, Signal Corps, U. S. A.; died in service (Arcadia, Cal.), January 6th, 1919.*

*REILLY, CHARLES GILBERT.* *Capt., U. S. A., Co. D, 313th Inf.; killed in action (France), October 1st, 1918.*

*MARRIAN, RALPH RICHARDSON.* *2d Lieut., U. S. A., Co. B, 105th Engrs.; killed in action (France), October 17th, 1918.*

**Abbot, Frederic V.** Brig.-Gen., Engineers, U. S. A.

**Abbot, Frederick William.** Lt.-Col., British Army.

**Acher, A. H.** Maj., Engineers, U. S. A.; Acting Lt.-Col., 4th Engrs., A. E. F., France.

**Acker, Robert L.** Corporal, Headquarters Co., 7th F. A., A. E. F., France.

**Ackerman, Alexander S.** Capt., Engineers, U. S. A., A. E. F., France.

**Ackerman, Arthur P.** 1st Lieut., Engineers, U. S. A., 517th Engrs.

**Adams, Arthur.** Lt.-Col., Ordnance, U. S. A.

**Adams, Edward M.** Maj., U. S. A.

**Adams, Milton Jewell.** Capt., Engineers, U. S. A., Co. C, 114th Engrs.

**Adams, Raymond E.** Capt., Quartermaster Corps, U. S. A.

**Adams, Walter Francis.** Sergeant, Co. E, 2d Bn., 23d Engrs., A. E. F., France.

**Adams, William H.** Capt., Quartermaster Corps, U. S. A.

**Albert, Frederick W.** Lt.-Col., Engineers, U. S. A., 33d Engrs., A. E. F., France.

**Alden, Herbert C.** 1st Lieut., Coast Artillery, U. S. A.

**Alden, Langford Taylor.** Aspirant, 7e Batterie, 51st Regt. d'Artillerie, Secteur Postal No. 82 (French Army); Care, Morgan, Harjes Cie., Boulevard Haussmann, Paris, France.

**Alderman, Ernest S.** Lieut., Quartermaster Corps, U. S. A.

**Alexander, Kay.** Maj., 12th Canadian Ry. Troops, B. E. F., France.

**Allen, Franklin R.** Capt., Engineers, U. S. A., 603d Engrs., A. E. F., France.

**Allen, Herschel Heathcote.** Capt., Engineers, U. S. A.

**Allen, Ralph B.** 1st Lieut., Engineers, U S. A., Co. B, 25th Engrs., A. E. F., France.

**Allen, Raymond C.** Capt., Quartermaster Corps, U. S. A.

**Allen, Walter Henry.** Maj., Engineers, U. S. A.

**Allen, Walter Hinds.** Commander, Civil Engineer Corps, U. S. N.

**Allison, William F.** Maj., Engineers, U. S. A., A. E. F., France.

**Altman, Frank S.** Capt., Engineers, U. S. A., 23d Engrs., A. E. F., France.

**Altstaetter, F. W.** Col., Engineers, U. S. A.

**Anders, Frank L.** Capt., Quartermaster Corps, U. S. A.

**Anderson, C. L. B.** Lieut., Civil Engineer Corps, U. S. N.

**Anderson, J. E.** Maj., 212th Field Co., Royal Engrs., B. E. F., France.

**Anderson, W. P.** Capt., Engineers, U. S. A., A. E. F., France.

**Anderson, W. S.** Cadet, School of Military Aeronautics, U. S. A.

**Andrew, Clarence R.** Capt., Engineers, U. S. A., 32d Engrs., A. P. O. 705, A. E. F., France.

**Andrews, J. H. M.** Lt.-Col., Ordnance, U. S. A.

**Angas, Robert M.** 1st Lieut., U. S. A., 106th Engrs.

**Applegarth, Gault.** Capt., Engineers, U. S. A., 23d Engrs., A. E. F., France.

**Arakawa, Futoshi.** 2d Lieut., Co. K, 1st Hawaiian Inf., U. S. A., Schofield Barracks, Hawaii.

**Ardery, Edward Dahl.** Col., Engineers, U. S. A.

**Armitage, George W.** Maj., Quartermaster Corps, U. S. A.

**Armstrong, Charles Johnstone.** Brig.-Gen.; Chf. Engr., H. Q., Canadian Army Corps, B. E. F., France.

**Armstrong, Merwin.** Capt., Engineers, U. S. A., Co. D, 105th Engrs., A. E. F., France.

**Armstrong, Roger W.** Capt., Quartermaster Corps, U. S. A.

**Arn, William G.** Maj., Engineers, U. S. A., 2d Bn., 13th Engrs. (Ry.), A. E. F., France.

**Arnold, Bion J.** Lt.-Col., Air Service, U. S. A.

**Ashkins, Nathan Thomas.** 1st Lieut., Engineers, U. S. A., Lines of Communication, Eng. Headquarters, A. E. F., France.

**Ashley, Carl.** Capt., Engineers, U. S. A., U. S. M. P. O. 702, A. E. F., France.

**Ashmead, P. H.** Maj., Engineers, U. S. A.

**Ashton, Raymond.** 2d Lieut., Air Service, U. S. A., A. E. F., France.

**Asplundh, E. T.** Capt., Engineers, U. S. A., 103d Engrs., A. P. O. 744, A. E. F., France.

**Asserson, Henry Raymond.** Maj., Engineers, U. S. A., C. E. L. O. C., A. E. F., France.

**Atterbury, W. W.** Brig.-Gen.; Director-General of Transportation, A. E. F., France.

**Atwood, William G.** Lt.-Col., Engineers, U. S. A., 17th Engrs. (Ry.), U. S. A. P. O. 701, A. E. F., St. Nazaire, France.

**Austin, H. A. R.** 1st Lieut., Engineers, U. S. A.

**Ayres, John Henry.** Capt., Engineers, U. S. A., Co. D, 42d Engrs.

**Ayres, Quincy C.** 2d Lieut., Engineers, U. S. A. (*Unattached*), A. E. F., France.

**Bailey, Lewis P.** Capt., Engineers, U. S. A., Co. A, 304th Engrs.

**Bakenhus, R. E.** Commander, Civil Engineer Corps, U. S. N.

**Baker, George L.** Capt., U. S. A., Co. C, 13th Bn., U. S. Guards.

**Baker, H. S.** Col., Engineers, U. S. A., 111th Engrs., 36th Div., A. E. F., France.

**Baker, Shirley.** Capt., Engineers, U. S. A., Co. B, 23d Engrs.

**Balch, William H.** Maj., Engineers, U. S. A., A. P. O. 717, A. E. F., France.

**Barber, Charles W.** Private, 38th Engrs.

**Barber, Justin F.** Sergeant, Co. M, 23d Engrs., A. E. F., France.

**Barber, Norman N.** Capt., Engineers, U. S. A., 16th Engrs., A. E. F., France.

**Barclay, A. J.** 1st Lieut., Engineers, U. S. A.

**Barnard, Archer F.** 1st Lieut., Engineers, U. S. A.

**Barney, Samuel E.** Maj., Engineers, U. S. A. (*Unassigned*).

**Barry, E. J.** Maj., Engineers, U. S. A.

**Bartholomew, B. W.** 1st Lieut., Engineers, U. S. A., 301st Engrs., A. E. F., France.

**Bascom, George R.** Maj., Sanitary Corps, U. S. A.

**Bass, Fred T.** Capt., Engineers, U. S. A., Headquarters, 1st Bn., 32d Engrs., A. E. F., France.

**Bassett, Herbert H.** Maj., Engineers, U. S. A.

**Battie, H. S.** 1st Lieut., Engineers, U. S. A.

**Baver, Walter S.** Lieut., Sanitary Corps, U. S. A.

**Baxter, O. G.** Capt., Engineers, U. S. A., Co. C, 601st Engrs.

**Bayliss, Paul.** 2d Lieut., Engineers, U. S. A., 8th Engrs. (Mounted).

**Beach, Lansing H.** Col., Engineers, U. S. A.

**Beale, Allan S.** Lieut., U. S. Air Service (Aeronautics).

**Beall, Pendleton.** Private, Headquarters Co., 165th Inf., A. E. F., France.

**Beam, Carl Eugene.** 2d Lieut., Engineers, U. S. A., 541st Engrs., A. E. F., France.

**Bean, Paul Jones.** Civ. Engr., U. S. N.

**Beebe, James W.** Capt., Engineers, U. S. A.

**Beeman, Thomas R.** Capt., Engineers, U. S. A., Care, Chf. Engr., A. E. F., France.

**Begg, R. B. H.** Capt., Engineers, U. S. A., A. E. F., France.

**Behrman, I. E.** Capt., Engineers, U. S. A., Care, C. E. O., A. E. F., France.

**Bell, George Edward.** Lieut., Canadian Engrs., Care, Dominion Bridge Co., Ltd., Montreal, Que., Canada.

**Bell, Harry W.** Capt., Engineers, U. S. A., 5th Bn., 22d Engrs., A. E. F., France.

**Bellinger, L. F.** Commander, Civil Engineer Corps, U. S. N.

**Benham, Claude Gilbert.** Capt., Coast Artillery, U. S. A.

**Benham, W. L.** Maj., Quartermaster Corps, U. S. A.

**Bennett, John W. F.** Maj., Quartermaster Corps, U. S. A., Constr. Div.

**Bennison, Ernest William.** 1st Lieut., Engineers, U. S. A., 23d Engrs.

**Benson, Orville.** Maj., Engineers, U. S. A., A. E. F., France.

**Berdeau, Ray W.** Capt., Engineers, U. S. A.; Engr. Officer, 220th Engrs.

**Bessey, Roy F.** Lieut., U. S. A., Co. B, 57th Engrs., A. E. F., France.

**Bickel, George R.** Chf. Machinist's Mate, U. S. N. R. F.

**Biddle, John.** Maj.-Gen., U. S. A.

**Billings, Fred M.** Capt., Engineers, U. S. A.

**Binckley, George Sydney.** Maj., Engineers, U. S. A., 112th Engrs., A. E. F., France.

**Binger, Walter D.** 2d Lieut., Signal Corps, U. S. A.

**Bird, Byron.** 2d Lieut., Signal Corps, A. S., U. S. A.

**Birdseye, Claude H.** Maj., Engineers, U. S. A., Office, Chf. of Artillery, A. P. O. 706, A. E. F., France.

**Bishop, Roy P.** 2d Lieut., Engineers, U. S. A.; Personnel Adjt., 35th Engrs., A. E. F., La Rochelle, France.

**Bissell, C. T.** Capt., Quartermaster Corps, U. S. A.

**Bither, T. A.** 2d Lieut., Signal Corps, Aviation Section, U. S. A.

**Bixby, William H.** Brig.-Gen., U. S. A. (*Retired*).

**Black, Dudley F.** Capt., Engineers, U. S. A., Co. C, 513th Engrs., A. E. F., France.

**Black, E. B.** Maj., A. S. (P.), U. S. A.

**Black, G. G.** Capt., Engineers, U. S. A.; Acting Adjt., 314th Engrs.

**Black, James B.** Capt., Engineers, U. S. A., Office, D. M. E. and E. S., A. P. O. 717, A. E. F., France.

**Black, Ralph P.** 1st Lieut., Engineers, U. S. A., 32d Engrs.

**Black, Roger Derby.** Col., Gen. Staff, U. S. A.

**Black, Walter G.** 1st Lieut., Co. 7, E. O. T. S., Camp A. A. Humphreys, Va.

**Black, William M.** Maj.-Gen., U. S. A.; Chf. of Engrs., U. S. A.

**Blackman, J. W. B.** Lieut., Canadian Ry. Troops, C. E. F., France.

**Blair, Alexander.** 2d Lieut., Royal Engrs., B. E. F., France.

**Blair, McCrea Parker.** Capt., No. 1 Depot Bn., Manitoba Regt., Winnipeg, Man., Canada.

**Blanchard, Murray.** Maj., Engineers, U. S. A., 520th Engrs.

**Blauvelt, Louis D.** Maj., Quartermaster Corps, U. S. A.

**Blucher, Conrad M. von.** 1st Lieut., Engineers, U. S. A.

**Boesch, Clarence E.** Capt., U. S. A., Co. B, 105th Engrs.

**Boggs, F. C.** Col., U. S. A., 315th Engrs.

**Boland, Charles J.** 1st Lieut., Signal Corps, U. S. A., 492d Constr. Div., A. E. F., France.

**Bolger, Edwin Gibson.** Barron Field, Everman, Tex.

**Bolin, Harry W.** Sergeant, Co. E, 23d Engrs.

**Bolton, Frank L.** Capt., Engineers, U. S. A.

**Bond, P. S.** Col., U. S. A., 107th Engrs.; Div. Engr., 32d Div., Army Engr. School, U. S. P. O. 714, A. E. F., France.

**Boorman, Kitchell M.** Lieut., U. S. A., Office, Chf. Engr., 2d Army, A. P. O. 784, A. E. F., France.

**Booth, Raymond.** 1st Lieut., Engineers, U. S. A., 54th Engrs.

**Borchers, Perry E.** Capt., Engineers, U. S. A.

**Borden, Guy.** Lieut., Engineers, U. S. A.

**Boschke, Guy.** Maj., Engineers, U. S. A., M. P. O. 705, A. E. F., France.

**Bott, C. N.** Capt., Engineers, U. S. A., 27th Engr. Service Co. (Forestry), A. E. F., France.

**Boult, Charles N.** 2d Lieut., 28th Reinforcements, New Zealand Engrs., N. Z. E. F., Care, P. O., Wellington, New Zealand.

**Bowe, Thomas F.** Capt., Quartermaster Corps, U. S. A., Constr. Div.

**Bowen, Charles K.** Capt., Engineers, U. S. A.

**Bowie, William.** Maj., Engineers, U. S. A.

**Bowlby, Henry L.** Lt.-Col., Engineers, U. S. A.

**Bowne, Sidney B.** 2d Lieut., U. S. Public Health Service.

**Boyd, George R.** Capt., Engineers, U. S. A., A. E. F., France.

**Boyden, Harry C.** Maj., Engineers, U. S. A.

**Brace, James H.** Maj., U. S. A., 22d Engrs., A. E. F., France.

**Bragg, Kendal B.** Lieut., Civil Engineer Corps, U. S. N.

**Braly, Raymond F.** 1st Lieut., Engineers, U. S. A.

**Braunworth, Percy L.** Capt., Engineers, U. S. A., Care, Director-General of Transportation, Army P. O. 705, A. E. F., France.

**Breck, Charles R., Jr.** Capt., Engineers, U. S. A., 31st Engrs., A P. O. 718, A. E. F., France.

**Bres, Edward Sedley.** Capt., Engineers, U. S. A., 114th Engrs., 1st Army Corps, A. E. F., France.

**Brewster, Henry B.** Capt., Engineers, U. S. A., and Adjt., 66th Engrs., A. E. F., France.

**Breymann, John B., Jr.** 2d Lieut., Coast Artillery, U. S. A., 22d Co.

**Briggs, Robert W.** 2d Lieut., Signal Corps, Aviation Section, U. S. A., 73d Aero Constr. Squadron.

**Bright, Graham B.** Capt., Engineers, U. S. A., and Regimental Adjt., 305th Engrs. (Pioneers).

**Brinkley, Milo H.** Capt., Engineers, U. S. A.

**Bronson, Howard F.** Capt., Sanitary Corps, U. S. A.

**Brook, A. E.** Capt., Royal Engrs., B. E. F., France.

**Brooking, J. H.** Capt., Engineers, U. S. A., Co. B, 12th Engrs. (Ry.), A. E. F., France.

**Brooks, Josiah R.** 1st Lieut., Engineers, U. S. A.

**Brower, I. C.** Maj., Quartermaster Corps, U. S. A., Constr. Div.

**Brown, Charles E.** Capt., Engineers, U. S. A.

**Brown, Clarence C.** Capt., Engineers, U. S. A.; Bn. Adjt., 12th Engrs. (Ry.), A. E. F., France.

**Brown, Earl I.** Col., U. S. A., 317th Engrs.

**Brown, Elbert C.** Capt., Engineers, U. S. A., 217th Engrs.

**Brown, Elliot C.** Lt.-Commander, U. S. N. R. F.

**Brown, H. Whittemore.** 2d Lieut., Engineers, U. S. A., A. E. F., France.

**Brown, Levant R.** Capt., Engineers, U. S. A.

**Brown, Marshall W.** Maj., Engineers, U. S. A., P. O. 702, A. E. F., France.

**Brown, Norman F.** Maj., Railroad Transportation Corps, U. S. A., Care, Director-Gen. of Transportation, A. E. F., France.

**Brownell, E. H.** Commander, Civil Engineer Corps, U. S. N.

**Bruner, Louis S.** 1st Lieut., U. S. A., Co. I, 23d Engrs., A. E. F., France.

**Brush, Carl F.** Capt., Engineers, U. S. A., A. P. O. 716, A. E. F., France.

**Bruton, Philip G.** 2d Lieut., A. S. (A. P.), U. S. A.

**Bryan, Clark A.** Capt., Engineers, U. S. A.

**Buchanan, Warren Henderson.** Ensign, U. S. N. R. F.

**Bucher, Harold F.** Lieut., Engineers, U. S. A., 544th Engrs., A. E. F., France.

**Buck, Walter Van.** Capt., Engineers, U. S. A., 23d Engrs.

**Bull, George M.** , Civ. Engr., U. S. N. R. F.

**Bunker, George H.** Capt., Engineers, U. S. A., 306th Engrs.

**Bunker, Stephen S.** Capt., Engineers, U. S. A., Co. A, 72d Engrs., A. E. F., France.

**Burd, Edward M.** Capt., Coast Artillery, U. S. A.

**Burdett, O. L.** Capt., Engineers, U. S. A., Co. A, 25th Engrs., A. E. F., France.

**Burgess, Harry.** Col., U. S. A.

**Burkett, Joseph M.** Capt., Engineers, U. S. A., A. E. F., France.

**Burky, C. R.** Capt., Signal Corps, Aviation Section, U. S. A.

**Burr, Edward.** Col., Engineers, U. S. A., Manila, Philippine Islands.

**Burrell, Glenn S.** Lt.-Commander, Civil Engineer Corps, U. S. N.

**Burroughs, Hector Robins.** Capt., Engineers, U. S. A. (*Unassigned*).

**Burrowes, H. G.** Capt., Engineers, U. S. A., Co B, 25th Engrs., A. E. F., France.

**Burt, Henry J.** Maj., Quartermaster Corps, U. S. A.

**Burton, William.** Capt., Engineers, U. S. A., 521st Engrs., A. E. F., France.

**Bush, Lee M.** 2d Lieut., Field Artillery, U. S. A.

**Bush, Lincoln.** Col., Quartermaster Corps, U. S. A.

**Bushnell, Howard B.** Capt., Engineers, U. S. A., 23d Engrs.

**Bushnell, Howard E.** Capt., Engineers, U. S. A.

**Busse, Franz A.** Capt., Engineers, U. S. A.; Director of Military Eng. and Engr. Supplies of France, Tours, France.

**Butler, John Soule.** Lt.-Col., Engineers, U. S. A.

**Butler, Millard A.** Col., Quartermaster Corps, U. S. A.

**Butler, William P.** Lieut., U. S. N. R. F.

**Byam, L. H.** Capt., Engineers, U. S. A.

**Byllesby, Henry M.** Maj., Signal Corps, Aviation Section, U. S. A.

**Byrd, J. H.** Capt., Engineers, U. S. A., 314th Engrs.

**Byrne, Thomas Sneed.** Capt., Ordnance, U. S. A.

**Caffall, Geoffrey A.** Private, No. 1 Coy., Canadian Machine Gun Depot, Seaford, Sussex, England.

**Caldwell, William H.** Lieut., U. S. N. R. F.

**Cameron, Harry Frank.** Lt.-Col., U. S. A., 209th Engrs.

**Camp, George Dashiell.** 1st Lieut., Engineers, U. S. A., 316th Engrs.

**Campbell, Charles C.** Corporal, Casual Co., Medical Detachment No. 2, U. S. A.

**Canfield, George Hathaway.** Lt.-Col., Engineers, U. S. A., 316th Engrs., A. P. O. 776, A. E. F., France.

**Carey, Matthew L.** Capt., Quartermaster Corps, U. S. A., A. E. F., France.

**Carey, William N.** Maj., U. S. A., 1st Bn., 313th Engrs., A. E. F., France.

**Carlin, J. P.** Capt., Engineers, U. S. A.

**Carlson, Carl Alexius.** Commander, Civil Engineer Corps, U. S. N.

**Caro, Phillip.** Lieut., 2d Junior Co., No. 4 Command Depot, A. T. F., Codford, Wiltshire, England.

**Carroll, James E.** Maj., Engineers, U. S. A., 527th Engrs., A. P. O. 701, A. E. F., France.

**Carter, E. Kemper.** Capt., Engineers, U. S. A., Co. C, 518th Engrs.

**Case, Charles A.** Capt., Engineers, U. S. A., 314th Engrs., 87th Div., A. E. F., France.

**Cate, Charles Edward.** Capt., U. S. A., 45th Engrs., A. E. F., France.

**Caton, John H., 3d.** Capt., Engineers, U. S. A., Co. F, 33d Engrs.

**Cattell, William A.** Maj., Engineers, U. S. A.

**Cerny, John W.** Maj., Quartermaster Corps, U. S. A.

**Chadwick, Maurice F.** Corporal, Battery C, 6th Regt., 2d Brigade, F. A. R. D., Camp Jackson, S. C.

**Chamberlaine, Robert L.** Capt., Air Service (A. P.), U. S. A.

**Chambers, Frank T.** Capt., Civil Engineer Corps, U. S. N.

**Chandler, William E.** Master Gunner, Headquarters Co., 55th Artillery, C. A. C., A. P. O. 723, A. E. F., France.

**Chapman, Mellville D.** Capt., U. S. Marine Corps, Machine Gun Bn., 5th Brigade, A. E. F., France.

**Chapman, S. A.** 1st Lieut., U. S. A., Headquarters, 2d Bn., 10th Engrs. (Forestry), A. E. F., France.

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**Tilden, Charles Joseph.** Capt., Engineers, U. S. A. (*Unassigned*).

**Tinkham, Ralph R.** Capt., Engineers, U. S. A., 420th Engrs.

**Tinsley, R. B.** Capt., Engineers, U. S. A., Co. C, 605th Engrs., A. E. F., France.

**Tirrell, Charles Edwards.** Lieut., U. S. A., Headquarters, U. S. Air Service, Paris, France.

**Todd, Frank Herbert.** Maj., Quartermaster Corps, U. S. A.

**Todd, Oliver J.** Capt., Engineers, U. S. A., A. P. O. No. 780, A. E. F., France.

**Tolles, F. C.** Capt., Engineers, U. S. A., 112th Engrs, A. E. F., France.

**Tomlinson, Alfred Thomas.** Maj., Canadian Engrs.; Insp., Small Arms Ammunition, Dominion Arsenal, Lindsay, Ont., Canada.

**Tompkins, Robert Harry.** 1st Lieut., U. S. A., 111th Engrs., A. E. F., France.

**Topping, Perry.** Capt., Engineers, U. S. A., 5th Engrs.

**Torrance, William M.** Capt., Engineers, U. S. A.

**Townsend, C. McD.** Col., Engineers, U. S. A., 12th Engrs. (Ry.), A. E. F., France.

**Toyne, John Wilson.** Capt., Quartermaster Corps, U. S. A.

**Tracy, C. C.** Capt., Coast Artillery, U. S. A.

**Tracy, Herbert Herman.** 1st Lieut., Engineers, U. S. A., Engr. Wagon Co. 4, 23d Engrs., A. E. F., France.

**Travers-Ewell, Andrew.** Capt., Care, Gibbs & Co., Antofagasta, Chile.

**Treser, Albert Paul.** Co. A, 605th Engrs., A. E. F., France.

**Trimpi, Allan Littell.** 1st Lieut., U. S. A., 104th Engrs.

**Trout, Alexander Linn.** Capt., Engineers, U. S. A. (*Unassigned*), D. M. E. and E. S., A. E. F., Tours, France.

**True, Albert O.** Capt., Engineers, U. S. A.

**Trueblood, P. McG.** Lieut., U. S. N. R. F.

**Tucker, H. F.** Ensign, U. S. N. R. F.; Navigator, U. S. S. *Aroostook*.

**Turley, Jay.** Capt., Engineers, U. S. A.

**Turner, Daniel Norman.** 2d Lieut., Engineers, U. S. A., 304th Engrs.

**Turner, Nathaniel Parker.** Capt., U. S. A., Co. B, 111th Engrs., A. E. F., France.

**Tuska, Gustave R.** Maj., Engineers, U. S. A.

**Tyler, Richard G.** Capt., Quartermaster Corps, U. S. A.

**Tyson, William C.** Capt., Engineers, U. S. A., Co. No. 2, Camp Custer Replacement Draft, A. E. F., France.

**Uhler, W. D.** Lt.-Col., Quartermaster Corps, U. S. A.

**Van Amburgh, Thomas A.** 1st Lieut., Quartermaster Corps, U. S. A.

**Van Buren, Maurice Pelham.** Capt., Engineers, U. S. A., 602d Engrs.

**Vandemoer, John Jay.** Capt., U. S. A., 467th Engrs., A. E. F., France.

**Vandemoer, N. C.** Capt., Engineers, U. S. A.

**Vanderhoof, Arnold H.** Lieut., U. S. N. (*Retired*), Radio Div., Bureau of Steam Eng.

**Vandervoort, B. F.** Capt., Engineers, U. S. A.

**Vandevanter, Elliott.** Capt., Engineers, U. S. A., Co. D, 503d Engrs., A. E. F., France.

**Van Ness, R. A.** Capt., Engineers, U. S. A.; Regimental Adjt., 604th Engrs., A. E. F., France.

**Van Ornum, Samuel Judson.** Capt., Engineers, U. S. A.

**Van Suetendael, Achille O.** Capt., Engineers, U. S. A.

**Van Zile, Harry Lee.** Maj., Engineers, U. S. A., Office, D. of C. and F., S. O. S., A. E. F., France.

**Vaughan, Henry F.** Capt., Sanitary Corps, U. S. A.

**Verrill, George E.** Maj., Engineers, U. S. A.

**Vincent, J. I.** Capt., Ordnance, U. S. A.

**Vincent, W. H.** 1st Lieut., Engineers, U. S. A.

**Vogdes, Joseph J.** Capt., Railroad Transportation Corps, U. S. A., Care, D. G. T., A. E. F., France.

**Volk, Wendell Douglas.** Capt., Engineers, U. S. A.

**von Deesten, A. P.** Maj., Engineers, U. S. A.

**Wade, George W.** 1st Lieut., Co. D, 2d Bn., 117th Engrs., 42d Div., A. E. F., France.

**Wadsworth, George R.** Maj., Signal Corps, U. S. A.

**Wadsworth, Henry H.** Maj., Engineers, U. S. A.

**Wagner, Allan J.** Capt., Engineers, U. S. A.

**Wagner, John, Jr.** 1st Lieut., Cavalry, U. S. A., First Corps School, Army P. O. No. 703, A. E. F., France.

**Waite, Clement F.** 1st Lieut., Engineers, U. S. A.

**Waite, H. M.** Lt.-Col., Railroad Transportation Corps, U. S. A., Care, Railroad Transportation Corps, A. E. F., France.

**Waldron, Albert E.** Col., U. S. A., General Headquarters, American Army, A. E. F., Chaumont Haut Marne, France.

**Walker, Edward G.** Capt., Royal Air Service; 78 Cheyne Court, Chelsea, London, S. W. 3, England.

**Walker, Elton D.** Capt., Engineers, U. S. A., Co. A, 5th Engrs., A. E. F., France.

**Walker, Harry Bruce.** Capt., Engineers, U. S. A.

**Walker, Meriwether Lewis.** Col., Engineers, U. S. A., G. H. Q., A. E. F., France.

**Walker, W. Kemp.** Capt., Engineers, U. S. A.

**Wallace, David A.** Capt., Engineers, U. S. A., Headquarters, Director General of Transportation, A. P. O. 717, A. E. F., France.

**Wallace, Harold U.** Maj., Engineers, U. S. A.

**Waller, Alexander C.** 1st Lieut., Engineers, U. S. A., 22d Engrs., A. E. F., France.

**Waller, Percy.** Capt., Engineers, U. S. A.

**Walter, Frank E.** 1st Lieut., Co. B, 55th Engrs., A. E. F., France.

**Walton, H. B.** Capt., Engineers, U. S. A., 312th Engrs.

**Wanzer, James O.** 1st Lieut., U. S. A., 47th Engrs., A. E. F., France.

**Ward, George S.** 2d Lieut., Engineers, U. S. A., Co. A, 117th Engrs., A. E. F., France.

**Ward, Lyman Wise.** Capt., Coast Artillery, U. S. A.; Adjt., 1st Bn., 63d Artillery.

**Wardwell, Ralph W.** Capt., Engineers, U. S. A.

**Ware, Howard T.** 2d Lieut., Quartermaster Corps, U. S. A., Bakery Co. No. 317.

**Ware, John.** Capt., U. S. A., 101st Engrs., A. E. F., France.

**Ware, Norton.** Maj., Engineers, U. S. A.

**Warfield, Ralph M.** Lt.-Commander, Civil Engineer Corps, U. S. N.

**Waring, C. T.** Maj., Signal Corps, U. S. A.

**Warner, Elwin S.** Capt., Engineers, U. S. A.; Adjt., 1st Bn., 301st Engrs., Army of Occupation, Brohl-am-Rhein, Germany.

**Warnock, W. H.** Capt., Quartermaster Corps, U. S. A.

**Warren, Horace P.** Maj., U. S. A., 55th Engrs., A. E. F., France.

**Warren, James G.** Col., Engineers, U. S. A.

**Warren, Minton M.** Capt., Engineers, U. S. A.; Topographical Officer, 101st Engrs., 26th Div., A. E. F., France.

**Warren, Philip R.** Maj., Royal Engrs., 3 P. C., H. Q., B. A. P. O. 2, B. E. F., France.

**Waterman, Earle L.** 1st Lieut., Sanitary Corps, U. S. A.

**Watkins, Guy A.** Capt., Engineers, U. S. A.

**Watson, D. M.** Lieut., R. A. S. C., 123d Auxiliary Petrol Coy., B. E. F., France.

**Watson, George L.** Lt.-Col., Engineers, U. S. A., General Staff (A. C. of S. G. 2), Third Army Corps, Coblenz, Germany.

**Watson, Loyall F.** 1st Lieut., U. S. A., 403d Engrs.

**Watson, Winslow B.** 1st Lieut., U. S. A., 106th Inf.

**Waugh, William H.** Maj., Engineers, U. S. A.

**Way, W. F.** 1st Lieut., Engineers, U. S. A., 130th Engrs., A. E. F., France.

**Weaver, C. J.** 1st Lieut., Engineers, U. S. A.

**Weaver, Earll Chase.** Civ. Engr., U. S. N. R. F.

**Weaver, Frank L.** Capt., Engineers, U. S. A., 305th Engrs.

**Webb, Claude A.** 2d Lieut., Field Artillery, U. S. A., 121st F. A., A. E. F., France.

**Webb, De Witt Clinton.** Commander, Civil Engineer Corps, U. S. N.

**Webb, George H.** Col., 16th U. S. Engrs. (Ry.), A. E. F., France.

**Webb, Walter Loring.** Maj., Engineers, U. S. A., A. E. F., France.

**Weeks, W. C.** Lt.-Col., Engineers, U. S. A., 32d Engrs., A. P. O. 705, A. E. F., France.

**Weidman, William R.** Capt., Engineers, U. S. A., 547th Engrs.

**Welles, Theodore L., Jr.** 1st Lieut., Engineers, U. S. A., 318th Engrs., 6th Div., A. E. F., France.

**Wells, Emery.** 1st Lieut., Engineers, U. S. A., A. P. O. 712, A. E. F., France.

**Welsh, Russell D.** Corporal, Co. F, 115th Engrs., A. E. F., France.

**Wenige, Arthur E.** Maj., Engineers, U. S. A., 317th Engrs.

**Wenzell, Andrew P.** Maj., Engineers, U. S. A., 1st Bn., 16th U. S. Engrs. (Ry.), A. E. F., France.

**West, Edward Hazzard.** Capt., Engineers, U. S. A., 5th Engrs., 7th Div., A. E. F., France.

**West, Wade C.** Capt., Engineers, U. S. A.

**Wheat, G. Neville.** Capt., Engineers, U. S. A.

**Wheeler, Edgar True.** Capt., U. S. A., 125th Engrs.

**Wheeler, Frank I.** 1st Lieut., Air Service (A. P.), U. S. A.

**Wheeler, Robert C.** Capt., Quartermaster Corps, U. S. A.

**Wheelock, De Forest A.** Col., U. S. A.

**Whiteaker, Robert O.** Capt., U. S. A., 132d F. A.

**Whitman, Ezra B.** Maj., Quartermaster Corps, U. S. A.

**Whitman, Ralph.** Lt.-Commander, Civil Engineer Corps, U. S. N.

**Whitney, C. S.** Corporal, Co. F, 25th Engrs., A. P. O. 705, A. E. F., France.

**Whitney, John T.** 2d Lieut., Field Artillery, U. S. A., Co. C, 2d Corps Artillery Park, A. E. F., France.

**Whitney, Ralph Edward.** Capt., Sanitary Corps, U. S. A.

**Whitsit, Lyle A.** Capt., Engineers, U. S. A.

**Whitwell, E.** Capt., General Service Staff, British War Office, Robert Treat Hotel, Newark, N. J.

**Wickersham, John H.** Lt.-Col., Engineers, U. S. A.; Deputy Engr. Supply Officer, General Headquarters, P. O. 706, A. E. F., France.

**Widdicombe, R. A.** Maj., Engineers, U. S. A.

**Wiggin, Thomas H.** Capt., Engineers, U. S. A., Headquarters, Lines of Communications, A. E. F., France.

**Wiggins, Ralph Raymond.** 1st Lieut., Aviation Section, Signal Corps, U. S. A.

**Wilcox, Ernest Hardwick.** Capt., Engineers, U. S. A., 543d Engrs., A. E. F., France.

**Wild, H. J.** Maj., Engineers, U. S. A.

**Willard, George T.** Private, Co. E, 318th Engrs.

**Willard, N. R.** Capt., Engineers, U. S. A.

**Willcomb, George E.** Capt., Quartermaster Corps, U. S. A.

**Willcox, Henry.** Capt., Quartermaster Corps, U. S. A., Constr. Div.

**Williams, Alan F.** 2d Lieut., Co. B, 18th Engrs. (Ry.), U. S. Army P. O. No. 705, A. E. F., France.

**Williams, George D.** Capt., Engineers, U. S. A., Co. H, 548th Engrs., A. E. F., France.

**Williams, Samuel W.** Maj., Engineers, U. S. A.

**Williamson, Harry.** Capt., Royal Engrs.; O. C. 272d Ry. Constr. Co., R. E., E. E. F., Egypt.

**Williamson, Lee H.** 2d Lieut., Engineers, U. S. A., Co. A, 55th Engrs.

**Williamson, Sydney B.** Lt.-Col., Engineers, U. S. A.

**Williar, Harry D., Jr.** Maj., U. S. A., 1st Engrs., A. E. F., France.

**Willis, Walter John.** Lieut. (EDO).

**Wilson, Edbert C.** Capt., Engineers, U. S. A., A. P. O. 790, A. E. F., France.

**Wilson, Everitt W.** Capt., Engineers, U. S. A., Co. A, 304th Engrs.

**Wilson, Harry P.** Capt., Engineers, U. S. A., 310th Engrs.

**Wilson, Louis A.** Capt., U. S. A., 417th Engrs.

**Wilson, Robert B. M.** Capt., Engineers, U. S. A., 311th Engrs.

**Wilson, William R.** Maj., 23d Field Co., R. E., B. E. F., France.

**Wing, Charles B.** Maj., Engineers, U. S. A., 23d Engrs., A. P. O. 738, A. E. F., France.

**Winn, Walter E.** Lt.-Col., Engineers, U. S. A., 114th Engrs., A. E. F., France.

**Winn, Walter S.** Maj., Engineers, U. S. A.

**Winton, Walter Ferrell.** Lt.-Col., U. S. A.

**Wolff, R. B.** Capt., U. S. A.

**Wondries, Charles H.** 1st Lieut., Engineers, U. S. A., 428th Engrs.

**Wood, B. Russell.** Maj., Engineers, U. S. A., A. P. O. 713, A. E. F., France.

**Wood, Frederic J.** Maj., Engineers, U. S. A.

**Woodard, Wilkie.** Capt., Engineers, U. S. A., Co. H, 35th Engrs., A. P. O. 735, A. E. F., France.

**Woodle, Bernon Tisdale.** Capt., Engineers, U. S. A.

**Woodruff, Charles W.** 1st Lieut., U. S. A., 403d Engrs.

**Woodruff, Glenn B.** 1st Lieut., Engineers, U. S. A.

**Woodward, Edwin C.** Capt., U. S. A., 22d Engrs., A. E. F., France.

**Woolworth, W. H.** Maj., Infantry, U. S. A.

**Wooten, William P.** Col., Engineers, U. S. A., Headquarters, 3d Corps, A. E. F., France.

**Wright, Edward.** Capt., Sanitary Corps, U. S. A.

**Wright, Frederick J.** Corporal, Camp Headquarters Co., Camp Dix, N. J.

**Wright, Jesse B.** Capt., Engineers, U. S. A.

**Wright, John Bertram.** Capt., Engineers, U. S. A.

**Wrightson, William D.** Col., Sanitary Corps, U. S. A.

**Yates, Sheldon S.** Field Artillery Officers' Training Camp, Camp Zachary Taylor, Ky.

**Yeo, W. H. W.** Capt., Engineers, U. S. A.

**Yereance, Alex. W.** 1st Lieut., Co. F, 305th Engrs., A. E. F., France.

**Yost, Howard McC.** Maj., Engineers, U. S. A.

**Young, Charles C.** 1st Lieut., Engineers, U. S. A.

**Young, Frederick C.** Capt., Engineers, U. S. A.; Adjt., 114th Engrs., A. E. F., France.

**Young, George S.** Capt., Engineers, U. S. A., 29th Engrs.; Executive Officer, G-2-C, 2d Army, A. E. F., France.

**Zinn, George A.** Col., Engineers, U. S. A.

## MEMBERSHIP

(From January 3d to February 6th, 1919.)

### ADDITIONS

| MEMBERS | | Date of Membership |
|---|---|---|
| Anderson, Charles Irving. Engr. of Bridges and Bldgs. for the Corporate Co., Ill. Cent. R. R., 135 East 11th Pl., Room 800, Chicago, Ill. | | Jan. 13, 1919 |
| Anderson, Edward Stewart. Chf. Engr., Bannock Eng. Co., 230 Portneuf Bldg., Pocatello, Idaho. | | Jan. 13, 1919 |
| Beck, Edward Adam. 115 Georgia Ave., Goldsboro, N. C. | Assoc. M.<br>M. | May 6, 1914<br>Nov. 26, 1918 |
| Berthe, Lucius Tullius. Pres., Berthe Eng. Co., Charleston, Mo. | Assoc. M.<br>M. | May 6, 1914<br>Jan. 14, 1919 |
| Beyer, Theodore Alexander. Vice-Pres., James J. Burke & Co., 706 Kearns Bldg., Salt Lake City, Utah. | | Jan. 13, 1919 |
| Cohill, Andrew Arnold. Chf. Engr., P. McGovern & Co., 50 East 42d St., New York City. | | Jan. 13, 1919 |
| Gage, Ralph Hawes. Care, Gage Structural Steel Co., 3141 South Hoyne Ave., Chicago, Ill. | | Jan. 13, 1919 |
| Hackenberg, James Osberne. Div. Engr., Maryland Div., P. R. R., Room 202, Pennsylvania R. R. Bldg., Wilmington, Del. | | Jan. 13, 1919 |
| Lindsey, Alfred Raymond. (Franklin & Co.), 906 Crozer Bldg., Philadelphia, Pa. | Assoc. M.<br>M. | Sept. 3, 1912<br>Jan. 14, 1919 |
| Lynch, Alexander Sydney. Chf. Engr., Palmer & Lynch, 228 Park St., West Haven, Conn. | Jun.<br>Assoc. M.<br>M. | Dec. 6, 1910<br>June 4, 1913<br>Jan. 14, 1919 |
| Miller, Alexander Norman. Chf. Hydr. Engr., The Vulcan Iron Works Co., 1122 Detroit St., Denver, Colo. | Assoc. M.<br>M. | Dec. 31, 1913<br>Jan. 14, 1919 |
| Mosley, Earl Louis. Asst. Engr., Valuation Dept., Ill. Cent. R. R., B. and B. Dept., Room 1000, Central Station, Chicago, Ill. | Assoc. M.<br>M. | Sept. 6, 1910<br>Nov. 26, 1918 |
| Murray, Samuel. Chf. Engr., Ore.-Wash. R. R. & Nav. Lines, U. S. Railroad Administration, Portland, Ore. | Assoc. M.<br>M. | Jan. 8, 1908<br>Nov. 26, 1918 |
| Pistor, George Emil John. Constr. Engr., Hay Foundry & Iron Works, 15 Madison Sq., North, New York City. | Jun.<br>Assoc. M.<br>M. | Dec. 3, 1901<br>July 10, 1907<br>Jan. 14, 1919 |
| Rich, Barzillai Allen. With Fay, Spofford & Thorndike, 308 Boylston St., Boston, Mass. | | Jan. 13, 1919 |
| Russell, Herbert Lafayette. Cons. Engr., Moffat Blk., Detroit, Mich. | | Jan. 13, 1919 |
| Smith, Acheson. Vice-Pres. and Gen. Mgr., Acheson Graphite Co., P. O. Box 616, Niagara Falls, N. Y. | | Jan. 13, 1919 |

MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| VEATCH, NATHAN THOMAS, JR. Cons. Engr. (Black & Veatch). Interstate Bldg., Kansas City, Mo. | Jun. | Nov. 8, 1909 |
| | Assoc. M. | Oct. 1, 1913 |
| | M. | Jan. 14, 1919 |
| WOODWARD, FRANK COY. Herkimer, N. Y. | Assoc. M. | June 30, 1911 |
| | M. | Jan. 14, 1919 |

ASSOCIATE MEMBERS

| | | |
|---|---|---|
| ACKER, LAMAR. County Engr., Sabine County, Nacogdoches, Tex. | | Jan. 13, 1919 |
| ALEXANDER, ALBERT MANGUM. Asst. to Steel Supt., Fred T. Ley & Co., 60 South Conception St., Mobile, Ala. | Jun. | Sept. 2, 1914 |
| | Assoc. M. | Nov. 26, 1918 |
| ARNOLD, LEROY. Res. Engr., Sinclair Refining Co., 3721 Metropolitan Ave., Kansas City, Kans. | | Jan. 13, 1919 |
| BERDEAU, RAY WILLIAM. Capt., Engrs., U. S. A.; Bn. Commander 220th Engrs., Washington Barracks, Washington, D. C. | Jun. | May 31, 1916 |
| | Assoc. M. | Jan. 13, 1919 |
| BOYLE, THOMAS JOSEPH. Engr. of Roads and Bridges, Luzerne County, 1220 Wyoming Ave., Forty-Fort, Pa. | | Jan. 13, 1919 |
| BUELL, WALTER AUGUSTUS. Sales Engr., Barber-Greene Co., Aurora, Ill. | Jun. | Oct. 4, 1910 |
| | Assoc. M. | Jan. 13, 1919 |
| COLLISSON, WILLIAM HENRY, JR. City Engr., City Hall, Ocean City, N. J. | | Jan. 13, 1919 |
| DINSMORE, OLIVER RAYMOND. 629 Longstaff St., Missoula, Mont. | | Jan. 13, 1919 |
| DOUGHERTY, NATHAN WASHINGTON. Prof. of Civ. Eng., Univ. of Tennessee, Knoxville, Tenn. | | Jan. 13, 1919 |
| DUNN, EVERETT WESLEY. Dist. Engr., Iowa State Highway Comm., 3810 Peters Ave., Sioux City, Iowa | | Jan. 13, 1919 |
| EVERS, ERNEST. Res. Engr., California Highway Comm., Box 985, Arroyo Grande, Cal. | | Jan. 13, 1919 |
| FORD, ARTHUR JENKINS. Chf. Draftsman, Bureau of Power and Light, 334 South Westlake Ave., Los Angeles, Cal. | | Jan. 13, 1919 |
| FOX, ROBERT MYRON. Capt., Engrs., U. S. A., Student Co. 1, E. O. T. S., Camp A. A. Humphreys, Va.; Address 195 West Euclid Ave., Detroit, Mich. | | Jan. 13, 1919 |
| FRANKLIN, WILLIAM HAWLEY. 4223 Eighth Ave., N. E., Seattle, Wash. | Jun. | Feb. 6, 1912 |
| | Assoc. M. | Oct. 8, 1918 |
| GÓMEZ GAULT, JOSÉ ANTONIO. Box 713, Guayaquil, Ecuador | | Sept. 10, 1918 |
| GOODKIND, MORRIS. Structural Designer, J. G. White Eng. Corporation, Lewis Pl., Lynbrook, N. Y. | | Jan. 13, 1919 |
| GRUMM, FRED JUSTUS. Chf. Deputy County Surv.'s Office, San Diego County, 2898 Spruce St., San Diego, Cal. | | Jan. 13, 1919 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| HABERLE, EDWARD LOUIS. Draftsman and Bridge Insp., G. N. Ry., St. Paul (Res., 1310 Emerson Ave., North, Minneapolis), Minn. | Jun. | Dec. 3, 1913 |
| | Assoc. M. | Jan. 13, 1919 |
| HARDING, EDWARD CRITTENDEN, JR. Progress Engr., U. S. Nitrate Plant No. 4, Ancor, Ohio (Res., 46 Tremont Ave., Fort Thomas, Ky.) | Jun. | Sept. 2, 1914 |
| | Assoc. M. | Jan. 13, 1919 |
| HARRISSON, GERARDUS. Cons. Engr. (Goldmark & Harrisson), Larchmont Gardens, Larchmont, N. Y. | | Jan. 13, 1919 |
| HELM, FRANK. Office Engr., A., T. & S. F. Ry., 1234 Clay St., Topeka, Kans. | Jun. | April 7, 1915 |
| | Assoc. M. | Jan. 13, 1919 |
| JOHNSON, FRANCIS WHITTIER. Res. Engr., Raymond Concrete Pile Co., 18 Edmands St., Somerville, Mass. | Jun. | Sept. 12, 1916 |
| | Assoc. M. | Oct. 8, 1918 |
| JOLLEY, HAROLD DEAN. Chf. Engr., Concrete Eng. Co., Omaha National Bank Bldg., Omaha, Nebr. | | Jan. 13, 1919 |
| JUNG, JOHN FREDERICK. Designing Engr. and Chf. Draftsman, Am. Concrete Steel Co., 1145 Longfellow Ave., New York City | | Jan. 13, 1919 |
| KUCHAR, FRANK MILES. Prin. Asst. Engr., The J. G. White Eng. Corporation, U. S. Nitrate No. 2, Muscle Shoals, Ala. | Jun. | Oct. 3, 1911 |
| | Assoc. M. | Jan. 13, 1919 |
| LARKIN, EDWARD LEO. Archt., 461 Eighth Ave., New York City | | Jan. 13, 1919 |
| LAVALLE, PETER FRANCIS. Supt. of Maintenance, The Valier-Montana Land & Water Co., Valier, Mont. | | Jan. 13, 1919 |
| LOGAN, WILLIAM STEVENSON. 2106 Spring Garden St., Philadelphia, Pa. | | Nov. 26, 1918 |
| LONG, JAMES BLAIR. Engr., Whittaker & Diehl, 24 West Freedley St., Norristown, Pa. | | Jan. 13, 1919 |
| LONGSHORE, RICHARD LIPKEY. Asst. Engr., Detroit Div., Wabash Ry., Montpelier, Ohio | | Jan. 13, 1919 |
| MARTIN, GEORGE EARL. Capt., Engrs., U. S. A., 3d Bn., 23d Engrs., Am. Exp. Forces, France; Address, 1475 South Grant St., LaFayette, Ind. | Jun. | Nov. 4, 1914 |
| | Assoc. M. | Oct. 8, 1918 |
| MAULDIN, EARLE. With J. E. Sirrine, Superv. Engr., Camp Bragg, Fayetteville, N. C. | | Jan. 13, 1919 |
| MURRAY, JOSEPH AUGUSTINE, JR. Lieut. (Junior Grade), C. E. C., U. S. N. R. F., Public Works Office, Navy Yard, Philadelphia, Pa. | | Jan. 13, 1919 |
| PAGE, JOHN MARSHALL. 1st Lieut., Ord., U. S. A., Aberdeen Proving Ground, Aberdeen, Md. | | Jan. 13, 1919 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| PHILLIPS, HARRY JOHN. Dist. Engr., The Austin Co., 217 Broadway, New York City | | Jan. 13, 1919 |
| RIMBAULT, EMILE LEONARD. Mgr. of Eng. Dept. and Chf. of Structural and Mech. Dept., Edward F. Terry Mfg. Co., Grand Central Terminal (Res., 39 Seaman Ave.), New York City | Jun.<br>Assoc. M. | April 1, 1914<br>Jan. 13, 1919 |
| ROBERTS, GEORGE BRADEN. 1325 Lee St., Charleston, W. Va. | | Nov. 26, 1918 |
| SINGSTAD, OLE. With Chile Exploration Co., 2262 Eighty-third St., Brooklyn, N. Y. | | Jan. 13, 1919 |
| STEINBERG, MAX. Junior Hydrographic and Geodetic Engr., U. S. Coast and Geodetic Survey, Washington, D. C. | Jun.<br>Assoc. M. | Sept. 12, 1916<br>Jan. 13, 1919 |
| TERRELL, DANIEL VOIERS. Prof. of Civ. Eng., Univ. of Kentucky, Lexington, Ky. | | Jan. 13, 1919 |
| TRACK, FRANK ANTON. Superv. Insp. of Hull and Machinery, U. S. Shipping Board, Emergency Fleet Corporation; Res., 143 Hancock St., Brooklyn, N. Y. | | Sept. 10, 1918 |
| TRASK, CLARENCE HENRY. Res. Engr., Du Pont Eng. Co., Penniman, Va. | | Jan. 13, 1919 |
| TRINKAUS, WILLIAM HENRY. Asst. Engr., San. Dist. of Chicago, 708 North May St., Chicago, Ill. | | Jan. 13, 1919 |
| VAN TRUMP, SAMUEL NEWBOLD. Chf. Engr., Water Dept., Wilmington, Del. | | Jan. 13, 1919 |
| VAUGHN, ROMNEY LEIGH. Gen. Supt., Standard Am. Dredging Co., 414 Thirteenth St., Oakland, Cal. | Jun.<br>Assoc. M. | Sept. 3, 1912<br>Sept. 10, 1918 |
| WALKER, ROBERT YULE. Contr. (Taylor & Walker), 601 Majestic Bldg., Oklahoma, Okla. | Jun.<br>Assoc. M. | May 6, 1914<br>Jan. 13, 1919 |
| WATSON, MARTIN WALLACE. Acting State Highway Engr., Kansas Highway Comm., Topeka, Kans. | | Jan. 13, 1919 |
| WESTENHOFF, ALPHONSE MUELLER. Designer, Chf. Engr.'s Office, C., C., C. & St. L. Ry., 1614 Westmoreland Ave., Cincinnati, Ohio | Jun.<br>Assoc. M. | Mar. 2, 1915<br>Jan. 13, 1919 |
| WILLIAMS, GUY MORRIS. Associate Engr., Bureau of Standards, Dept. of Commerce, Washington, D. C. | | Jan. 13, 1919 |
| WILSON, HENRY HARRISON. Res. Managing Partner, Winston & Co., Pennsboro, W. Va. | | Nov. 26, 1918 |

JUNIORS

| | | |
|---|---|---|
| BOMAR, JOHN EARLE. Levelman, Braden Copper Co., Rancagua, Chile | | Oct. 8, 1918 |
| DOWD, MUNSON JULIUS. 624 Juniper Ave., Long Beach, Cal. | | Jan. 13, 1919 |

JUNIORS (*Continued*)

| | Date of Membership |
|---|---|
| GERIG, FRANCIS AUSTIN. Dumas, Ark. | Sept. 10, 1918 |
| GLESSNER, MAURICE DAVID. Lieut., Engrs., U. S. A., Co. 1, Sec. A., E. O. T. S., Camp A. A. Humphreys, Va. | Jan. 13, 1919 |
| KWAN, TSU-CHANG. Drafting Dept., Tientsin-Pukow R. R. Office, Tientsin, China. | Oct. 8, 1918 |
| MARTIN, LLOYD LITTELL. 703 North 2d St., Harrisburg, Pa. | Oct. 8, 1918 |
| O'BRIEN, JAMES BRUCE. Central Hershey, Habana, Cuba. | Sept. 10, 1918 |
| TILLOTSON, ELBERT SAUNDERS. 124 East 19th St., Brooklyn, N. Y. | Nov. 26, 1918 |

## REINSTATEMENTS

ASSOCIATE MEMBERS

| | Date of Reinstatement |
|---|---|
| COLEMAN, HENRY FITCH. | Jan. 13, 1919 |

## RESIGNATIONS

MEMBERS

| | Date of Resignation |
|---|---|
| FITZGERALD, JOHN LELAND. | Dec. 31, 1918 |
| MERYWEATHER, HENRY FRANCIS. | Dec. 31, 1918 |
| WATSON, WILLIAM CRAVEN. | Dec. 31, 1918 |

ASSOCIATE MEMBERS

| | |
|---|---|
| POTTER, JAMES ROWLAND. | Dec. 31, 1918 |
| KEANEY, CHARLES FRANKLIN. | Dec. 31, 1918 |
| WATSON, WALTER. | Dec. 31, 1918 |
| ZORN, GEORGE WASHINGTON. | Dec. 31, 1918 |

JUNIORS

| | |
|---|---|
| MORGAN, WILLIAM RICHARD. | Dec. 31, 1918 |
| WHELAN, CHARLES MALLORY. | Dec. 31, 1918 |

## DEATHS

BELL, VICTOR HUGO. Elected Junior, March 14th, 1916; died in service January 6th, 1919.

BERGER, BERNT. Elected Associate Member, April 5th, 1893; died January 15th, 1919.

BROOKS, FREDERICK. Elected Junior, June 7th, 1876; Member, January 2d, 1884; died January 10th, 1919.

CARPENTER, ROLLA CLINTON. Elected Member, April 4th, 1911; died January 19th, 1919.

DUBOIS, GUSTAVO ADOLFO. Elected Junior, September 1st, 1908; Associate Member, May 6th, 1914; died August 30th, 1918.

GIBBS, WILLIAM WETMORE. Elected Junior, October 7th, 1914; Associate Member, May 15th, 1917; died January 13th, 1919.

HAVEN, WILLIAM APPLETON. Elected Member, March 5th, 1873; died January 6th, 1919.

HORTON, JOHN WILLIAM. Elected Junior, September 1st, 1908; Associate Member, December 2d, 1914; died December 24th, 1918.

JONES, GRANDVILLE REYNARD. Elected Junior, January 7th, 1908; Associate Member, May 2d, 1911; died December 22d, 1918.

KINGSLEY, MARVIN WATSON. Elected Member, July 3d, 1878; date of death unknown.

MARRIAN, RALPH RICHARDSON. Elected Junior, April 18th, 1916; killed in action (France), October 17th, 1918.

REILLY, CHARLES GILBERT. Elected Junior, May 7th, 1913; killed in action (France), October 1st, 1918.

STANTON, FRED CASWELL. Elected Associate Member, April 1st, 1908; Member, December 31st, 1913; died January 24th, 1919.

STONE, HENRY MORTON. Elected Member, April 3d, 1907; died December 8th, 1918.

**Total Membership of the Society, February 6th, 1919, 8 961.**

## MONTHLY LIST OF RECENT ENGINEERING ARTICLES OF INTEREST

(January 1st, to February 1st, 1919).

NOTE.—*This list is published for the purpose of placing before the members of this Society, the titles of current engineering articles, which can be referred to in any available engineering library, or can be procured by addressing the publication directly, the address and price being given wherever possible.*

### LIST OF PUBLICATIONS

*In the subjoined list of articles, references are given by the number prefixed to each journal in this list:*

(2) *Journal,* Engrs. Club of Phila., Philadelphia, Pa.
(3) *Journal,* Franklin Inst., Philadelphia, Pa., 50c.
(4) *Journal,* Western Soc. of Engrs., Chicago, Ill., 50c.
(5) *Journal,* Eng. Inst. of Canada, Montreal, Que., Canada.
(6) *Journal,* Am. Inst. of Archts., Washington, D. C., 50c.
(8) *Stevens Indicator,* Hoboken, N. J., 50c.
(9) *Industrial Management,* New York City, 25c.
(11) *Engineering* (London), W. H. Wiley, 432 Fourth Ave., New York City, 25c.
(12) *The Engineer* (London), International News Co., New York City, 35c.
(13) *Engineering News-Record,* New York City, 15c.
(15) *Railway Age,* New York City, 15c.
(16) *Engineering and Mining Journal,* New York City, 15c.
(17) *Electric Railway Journal,* New York City, 10c.
(18) *Railway Review,* Chicago, Ill., 15c.
(19) *Scientific American Supplement,* New York City, 10c.
(20) *Iron Age,* New York City, 20c.
(21) *Railway Engineer,* London, England, 1s. 2d.
(22) *Iron and Coal Trades Review,* London, England, 6d.
(24) *American Gas Engineering Journal,* New York City, 10c.
(25) *Railway Mechanical Engineer,* New York City, 20c.
(26) *Electrical Review,* London, England, 4d.
(27) *Electrical World,* New York City, 10c.
(28) *Journal,* New England Water-Works Assoc., Boston, Mass., $1.
(29) *Journal,* Royal Society of Arts, London, England, 6d.
(32) *Mémoires et Compte Rendu des Travaux,* Soc. Ing. Civ. de France, Paris, France.
(33) *Le Génie Civil,* Paris, France, 1 fr.
(36) *Cornell Civil Engineer,* Ithaca, N. Y.
(42) *Proceedings,* Am. Inst. Elec. Engrs., New York City, $1.
(43) *Annales des Ponts et Chaussées,* Paris, France.
(45) *Coal Age,* New York City, 10c.
(46) *Scientific American,* New York City, 15c.
(47) *Mechanical Engineer,* Manchester, England, 3d.
(54) *Transactions,* Am. Soc. C. E., New York City, $12.
(55) *Mechanical Engineering Journal,* Am. Soc. M. E., New York City, $10.
(56) *Transactions,* Am. Inst. Min. Engrs., New York City, $6.
(57) *Colliery Guardian,* London, England, 5d.
(58) *Proceedings,* Engrs.' Soc. W. Pa., 2511 Oliver Bldg., Pittsburgh, Pa., 50c.
(59) *Proceedings,* American Water-Works Assoc., Troy, N. Y.
(60) *Municipal and County Engineering,* Indianapolis, Ind., 25c.
(61) *Proceedings,* Western Railway Club, 225 Dearborn St., Chicago, Ill., 25c.
(62) *American Drop Forger,* Thaw Bldg., Pittsburgh, Pa., 10c.
(63) *Minutes of Proceedings,* Inst. C. E., London, England.
(64) *Power,* New York City, 5c.
(65) *Official Proceedings,* New York Railroad Club, Brooklyn, N. Y., 15c.
(66) *Gas Journal,* London, England, 6d.
(67) *Cement and Engineering News,* Chicago, Ill., 25c.
(71) *Journal,* Iron and Steel Inst., London, England.
(71*a*) *Carnegie Scholarship Memoirs,* Iron and Steel Inst., London, England.
(72) *American Machinist,* New York City, 15c.
(73) *Electrician,* London, England, 18c.
(74) *Transactions,* Inst. of Min. and Metal., London, England.
(75) *Proceedings,* Inst. of Mech. Engrs., London, England.
(77) *Journal,* Inst. Elec. Engrs., London, England, 5s.
(83) *Gas Age,* New York City, 15c.
(85) *Proceedings,* Am. Ry. Eng. Assoc., Chicago, Ill.
(86) *Engineering and Contracting,* Chicago, Ill., 10c.
(87) *Railway Maintenance Engineer,* Chicago, Ill., 10c.
(89) *Proceedings,* Am. Soc. for Testing Materials, Philadelphia, Pa., $5.

(90) *Transactions,* Inst. of Naval Archts., London, England.
(91) *Transactions,* Soc. Naval Archts. and Marine Engrs., New York City.
(92) *Bulletin,* Soc. d'Encouragement pour l'Industrie Nationale, Paris, France.
(93) *Revue de Métallurgie,* Paris, France, 4 fr. 50.
(96) *Canadian Engineer,* Toronto, Ont., Canada, 10c.
(98) *Journal,* Engrs., Soc. Pa., Harrisburg, Pa., 30c.
(99) *Proceedings,* Am. Soc. of Municipal Improvements, New York City, $2.
(100) *Professional Memoirs,* Corps of Engrs., U. S. A., Washington, D. C., 50c.
(101) *Metal Worker,* New York City, 10c.
(103) *Mining and Scientific Press,* San Francisco, Cal., 10c.
(104) *The Surveyor and Municipal and County Engineer,* London, England, 6d.
(105) *Chemical and Metallurgical Engineering,* New York City, 25c.
(106) *Transactions,* Inst. of Min. Engrs., London, England, 6s.
(107) *Schweizerische Bauzeitung,* Zürich, Switzerland.
(109) *Journal,* Boston Soc. C. E., Boston, Mass., 50c.
(110) *Journal,* Am. Concrete Inst., Philadelphia, Pa., 50c.
(111) *Journal of Electricity,* San Francisco, Cal., 25c.
(113) *Proceedings,* Am. Wood Preservers' Assoc., Baltimore, Md.
(114) *Journal,* Institution of Municipal and County Engineers, London, England, 1s. 6d.
(115) *Journal,* Engrs.' Club of St. Louis, St. Louis, Mo., 35c.
(116) *Blast Furnace and Steel Plant,* Pittsburgh, Pa., 15c.
(117) *Engineering World,* Chicago, Ill.
(118) *Times Engineering Supplement,* London, England, 2d.
(119) *Landscape Architecture,* Harrisburg, Pa., 50c.
(120) *Automotive Industries,* New York City, 15c.

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## LIST OF ARTICLES

### Bridges.

Strengthening a Long Steel Viaduct.* **(87)** Jan.
Strengthening a Telford Cast-Iron Bridge by Ferro-Concrete Arch Ribs.* W. Noble Twelvetrees. **(11)** Jan. 3.
The Sejourne System Wilson Bridge at Lyons, France.* **(86)** Jan. 22.
Pont Basculant de 42 Mètres de Portée à l'Entrée du Port de La Seyne (Rade de Toulon).* **(33)** Dec. 7, 1918.

### Electrical.

Heating Liquids by Electricity the Past, the Present and the Future.* H. O. Swoboda. **(58)** Nov., 1918
The Dynamical Theory of Electric Engines. Llewelyn B. Atkinson. (Tenth Kelvin Lecture). **(77)** Dec., 1918.
A New Graphic Method for Winding Schemes.* L. Fleischmann. **(73)** Dec. 13, 1918.
Cooling Electric Motors.* P. A. Mossay. (Abstract of paper read before Min. Inst. of Scotland). **(57)** Dec. 13, 1918.
Notes on Three-Phase Electric Haulage Equipment.* L. Fokes. **(57)** Dec. 20, 1918.
Testing D. C. Meters of the Ampere-Hour Type.* W. Hall. **(26)** Dec. 27, 1918.
Note on the Production of Continuous Electrical Oscillations by the Three-Electrode Valve.* E. V. L. Appleton. **(73)** Dec. 27, 1918.
Testing Direct-Current Watt-Hour Meters.* P. B. Findley. **(64)** Dec. 31, 1918.
Review of Work of Sub-Committee on Wave Shape Standard of the Standards Committee.* Harold S. Osborne. **(42)** Jan.
The Development of the Vacuum Valve.* **(111)** Jan. 1.
Material Required for Concrete Pole Foundations.* I. L. Kentish-Rankin. **(117)** Jan. 1.
Electricity Supply in Sheffield.* **(26)** Jan. 3.
Artificial and Natural Industrial Lighting.* C. E. Clewell. **(27)** Jan. 4.
When a Line Pole Needs a Guy.* Charles R. Harte. **(17)** Jan. 18.
An Operating View of High-Tension Insulators.* P. Ackerman. **(27)** Jan. 18.
New Plant of the Appalachian Power Company.* H. S. Slocum. **(27)** Jan. 18.
Some Peculiar Thermoelectric Effects. Paul D. Foote and T. R. Harrison. **(19)** Jan. 18.
Ammonia Condenser Data.* Henry Torrance. **(64)** Jan. 21.
Rebuilding 25 000-Kw. Generator.* Thomas Wilson. **(64)** Jan. 21.
Die Einschaltstrom von Wechselstrom-Transformatoren für die elektrische Traktion. W. Kummer. **(107)** Dec. 14, 1918.

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* Illustrated.

**Marine.**

The Fabricated Ship in America.* (12) Dec. 20, 1918.
Ford Methods in Ship Manufacture.* Fred E. Rogers. (9) Serial beginning Jan.
Fabricating Shop and Berth Equipment at Sun Shipyard.* (13) Jan. 2.
Aerial Cableways Successful in Northwest Shipyards.* (13) Jan. 2.
Build Boats in Dry Docks at New Yard in Detroit.* (13) Jan. 2.
Berth Construction and Side-Launching Practice in Great Lakes Shipyards.* (13) Jan. 2.
Routing of Fabricated Ship Material at Bristol.* (13) Jan. 2.
Emergency Shipbuilding on Lakes Handled by Erection Cranes of Many Types.* (13) Jan. 9.
Detail-Drawing Method Used for 8 800-Ton Steel Ships.* (13) Jan. 23.
Le Navire Frigorifique *Belle-Isle*.* Emile Gouault. (33) Dec. 28, 1918.

**Mechanical.**

Some Aspects of the Low-Temperature Carbonisation of Coal. Edgar C. Evans. (Abstract of paper read before Soc. of Chemical Industry.) (22) July 26, 1918.
New Critical Shaft Speeds as Effects of the Gyroscopic Disc-Action.* A. Stodola (11) Dec. 13, 1918.
Steam Turbine Governors.* J. Humphrey. (22) Dec. 13, 1918.
Benzol as a Motor Fuel. S. E. Whitehead. (66) Dec. 17, 1918.
Effect of "Direct" and "Indirect" Ammonia Recovery Upon Other By-Products. Thomas B. Smith. (Abstract of paper read before Coke Oven Managers' Assoc.) (22) Dec. 27, 1918.
Effect of Ammonia Recovery Methods on Other By-Products. T. B. Smith. (Paper read before Coke Oven Managers' Assoc.) (57) Dec. 27, 1918; (66) Dec. 24; (15) Jan. 10; (18) Jan. 11.
Burning the Low-Grade Coal of Iowa.* T. A. Marsh. (64) Dec. 31, 1918.
Influence of Gypsum on the Blast Furnace Slags in the Manufacture of Cement. Euphime Bereslavsky. (105) Jan. 1.
Exhaust Steam at High Back Pressures. Crosby Field. (105) Jan. 1.
Handling Powdered Coal as Fluid.* H. A. Kimber. (117) Jan. 1.
Automobile Performance Analyzed by Mechanical Differentiation.* Armin Elmendorf. (120) Jan. 2.
Austro-Daimler 200-Hp. Air Craft Engine.* (120) Jan. 2.
Turbine House Plant Operation. T. G. Otley and V. Pickles. (73) Jan. 3.
Steam Leakage in Dummies of the Ljungstrom Type. (11) Jan. 3.
First Description of the Ford "Baby" Tank.* (120) Jan. 9.
Steam Shovel Practice.* Llewellyn N. Edwards. (96) Jan. 9.
Some Tests with Flow Meters.* Joseph A. Maguire. (45) Jan. 9.
Changes in Beehive Coke Oven Construction Due to Mechanical Operation.* George W. Harris. (45) Jan. 9.
Getting Better Combustion of Indiana Coal.* T. A. Marsh. (27) Jan. 11.
Behavior of Steam in a Compound Engine. (64) Jan. 14.
Carbonization of Wood in the Stockholm Gas Works.* (83) Jan. 15.
Plant of the Seaboard By-Product Coke Company.* D. MacArthur. (83) Jan. 15.
Inclined Chamber Ovens at Auburn Junction.* (83) Jan. 15.
Heating Versus Power Boiler Rating. P. J. Dougherty. (64) Jan. 21.
Determination of Superheater Surface.* C. H. Baker. (64) Jan. 21.
Radiator Cooling Fans.* Louis Schwitzer. (120) Jan. 23.
An Analysis of the Hotchkiss Drive.* Otto M. Burkhardt. (Abstract of paper read before S. A. E.) (120) Jan. 23.
Duesenberg Sixteen-Cylinder Aircraft Engine.* (120) Jan. 23.
Why Do Ball Bearings Sometimes Fail? F. J. Jarosch. (72) Jan. 30.
Note sur la Vitesse Critique des Arbes et la Formule de Dunkerley.* E. Hahn. (107) Serial beginning Nov. 9, 1918.
Le Moteur Allemand d'Aéroplane, Système Maybach.* (33) Dec. 7, 1918.
Générateur de Vapeur Inexplosible Démontable, Système d'Espujols.* (33) Dec. 7, 1918.
Influence de l'Inclinaison des Aubes sur la Puissance des Ventilateurs.* Karrer. (33) Dec. 21, 1918.
Ueber den Einfluss der Schaufelwinkel auf die Leistung der Ventilatoren.* J. Karrer. (107) Nov. 16, 1918.

**Metallurgical.**

Application of the Electric Furnace to the Metallurgy of Iron and Its Alloys. H. Etchells. (Abstract of paper read before National Assoc. of Industrial Chemists.) (73) Dec. 27, 1918.
Micro-Metallography Illumination. Henry M. Sayers. (11) Dec. 27, 1918.
Electric Furnace Developments.* J. Bibery. (Abstract of paper read before Cleveland Inst. of Engrs.) (22) Dec. 27, 1918.
Electric Furnace Improvements During 1918. A. V. Farr. (116) Jan.
Electric Steel Mill Drive Developments.* Brent Wiley. (116) Jan.

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* Illustrated.

**Metallurgical—(Continued).**

Modern 500-Ton Brier Hill Blast Furnace.* (116) Jan.
New Plate Mills with Modern Lay-Out.* (116) Jan.
The Metallography of Aluminum.* Robert J. Anderson (3) Jan.
Heating Furnaces and Annealing Furnaces.* W. Trinks. (116) Serial beginning Jan.
Electric Furnaces for Steel Foundry Work. W. E. Moore. (Paper read before Am. Foundrymen's Convention.) (116) Jan.
Heating and Preheating Forging Furnaces.* (116) Jan.
Electric Heated Industrial Furnaces.* George J. Kirkgasser. (9) Jan.
Blast Furnace Plant Blows in First Stack.* (116) Jan.
Ancient and Modern Carbonizing Methods.* Theodore G. Selleck. (62) Jan.
Welding Heavy Plate Construction.* B. J. Dillon. (117) Jan. 1.
The Value of Observation in Works Practice.* H. H. Ashdown. (Paper read before Soc. of Engrs. and Metallurgists.) (11) Jan. 3.
Some Milling Applications and Adaptations.* (12) Jan. 3.
Dorr Thickener in Blast-Furnace Field.* (20) Jan. 9.
Notes on Electrical Precipitators.* Ernest Edgar Thum. (105) Jan. 15.
Furnace Settings for Caustic Pots.* Frank H. Nickle. (105) Jan. 15.
Electric Furnaces in the Steel Industry and Their Relation to the Central Station Business. (105) Jan. 15.
Building the Kempsmith Milling Machine.* M. E. Hoag. (72) Serial beginning Jan. 16.
Concentration of Lead-Zinc-Silver Ore at the Zinc Corporation's Mine.* George C. Klug. (103) Jan. 18.
Zirconia as a Refractory. E. H. Rodd. (19) Jan. 25.

**Military.**

Quartermaster Terminal Required for War Work.* Charles R. Gow. (28) Dec., 1918.
Railway Artillery.* James B. Dillard. (55) Jan.
Some Milling Applications and Adaptations. (12) Jan. 3.
First Description of the Ford "Baby" Tank.* (120) Jan. 9.
Le Navire Frigorifique *Belle-Isle*.* Emile Gouault. (33) Dec. 28, 1918.

**Mining.**

Cooling of Electric Motors, with Special Reference to Totally-Enclosed Machines.* P. A. Mossay. (Abstract of paper read before Min. Inst. of Scotland). (22) Dec. 13, 1918.
The "Amocab" Ferro-Concrete Pit Props.* (22) Dec. 20, 1918.
Notes on Three-Phase Electric Haulage Equipment.* L. Fokes. (57) Dec. 20, 1918.
Mercury Production at Almaden, Spain.* Roland Sterner-Rainer. (105) Jan. 1.
Mine Bathhouses in Utah.* A. C. Watts. (45) Jan. 2.
Coal Tipple and Washery at Lehigh, Mont.* E. P. Stewart. (45) Jan. 2.
Method and Cost of Coating Mine Roofs and Ribs by Cement Gun Process.* M. S. Sloman. (Abstract of article in *Mine and Quarry*). (86) Jan. 15.
Power Plants for Gold Dredging Installations in Isolated Districts. (86) Jan. 15.
Preparation of No. 4 Buckwheat in the Cone Separator.* (45) Jan. 23.
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Les Installations Electriques des Charbonnages de Blackhall (Angleterre).* (33) Jan. 4.

**Miscellaneous.**

Sound Fields and Sound Antennas. W. Hahnemann and H. Hecht. (11) Dec. 27, 1918.
Installing Employment Methods. William Alfred Sawyer. (9) Jan.
Establishing Basic Rates Saves Time Study Work.* Carle M. Bigelow. (9) Jan.
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The Fluid Ton. A. W. Allen. (16) Jan. 4.
The 34 Supermagic Square: Mathematical Recreations of Ancient Origin. F. J. Anderson. (From *Science Progress*). (19) Jan. 18.
The Ignition Temperature of Gaseous Mixtures. (19) Jan. 25.
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La Question du Froid, son Importance Economique et Sociale pour la France. Emile Gouault. (33) Dec. 21, 1918.
Les Tarifs de Salaire Moderne et l'Entreprise de Travaux Publics et du Bâtiment.* G. Bouf. (33) Jan. 4.

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Relation of the Curve to Town-Planning.* H. L. Seymour. (96) Jan. 9.

* Illustrated.

**Railroads.**

Quartermaster Terminal Required for War Work.* Charles R. Gow. (28) Dec., 1918.
Regenerative Braking with Single-Phase Commutator Motors.* H. Behn-Eschenburg. (73) Dec. 20, 1918.
The Electric Traction Return Circuit.* A. Johnston. (26) Dec. 20, 1918.
Transverse-Fissured Rails. G. F. Comstock. (22) Dec. 27, 1918.
Boiler-Setting Radiation and Air Leakage.* E. S. Hight. (64) Dec. 31, 1918.
Movable Car Dumper with Rotary Cradle.* A. F. Case. (116) Jan.
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True Cost Finding—What It can Do for the Railroads. Morris Llewellyn Cooke. (9) Jan.
West Burlington Shops of the C., B. & Q.* (25) Jan.
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Fourteen Points Essential to Establishing a Sound Railway Policy. L. C. Fritch. (13) Jan. 2.
Standard 2-10-2 and 4-8-2 Type Locomotives.* (18) Jan. 4.
Recent Developments in Service-at-Cost Franchises for Utilities. L. R. Nash. (17) Jan. 4.
Automatic Substations on the North Shore Line.* Charles H. Jones. (17) Jan. 11.
Electric Railway Snow Fighting Equipment and Its Applications. J. M. Pneuman. (Extracts from article in *Aera*). (86) Jan. 15.
New Locomotive Stoker Tested Out on Erie.* (15) Jan. 17.
Economics of the C. N. B. Tunnel at Montreal.* H. K. Wicksteed. (96) Jan. 23.
Le Laminage des Roues de Wagons par les Machines Slick, aux Usines de la Cambria Steel Co. à Johnstown (Pensylvanie, E-U.)* P. Calfas (35) Dec. 14, 1918.
Les Traction Electrique sur les Lignes du "Central Argentina". (35) Dec. 21. 1918.
Les Chemins de Fer de Campagne allemands.* G. Mangin. (33) Dec. 28, 1918.
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Die Erweiterung des Hauptbahnhofs Zürich.* (107) Serial beginning Nov. 30, 1918.
Ueber Drehmoment-und Geschwindigkeits-Verluste am Radumfang von Eisenbahnfahrzeugen.* W. Kummer. (107) Nov. 30, 1918.
Die Ventilationsanlage des Simplontunnels.* F. Rothpletz. (107) Serial beginning Jan. 4.

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The Federal Aid Road Law: Experience to Date and Suggestions for Better Co-operation.* Logan Waller Page. (60) Jan.
Latest Seattle Specifications for Brick Paving are for the Monolithic Type. W. H. Tiedeman. (60) Jan.
Road Contractor Successfully Employs Portable Charging Bins to Eliminate Dumping and Wheeling on Subgrade in Concrete Road Construction. George A. Burley. (60) Jan.
Experience with Sand Clay Road Surfacing in Nebraska.* George E. Johnson. (60) Jan.
Cracking of Concrete Roads and Its Prevention by Reinforcing with Steel. W. B. Sawyer, Jr. (Abstract of article in *Western Engineering.*) (67) Jan.
The Economic Limit to Motor Truck Weights. Robert C. Barnett. (86) Jan. 1.
Proposed Uniform Law for Regulation of Speed and Dimensions of Motor Trucks. George M. Graham. (86) Jan. 1.
Width of Provincial Highways.* W. A. McLean. (96) Jan. 9.
Bituminous Surfaces in York County, Ont. E. A. James. (Paper read before Ontario Good Roads Assoc.) (96) Jan. 16.
Developments in the Practice of Laying and Manufacturing Paving Materials. (13) Jan. 16.

**Sanitation.**

The Relative Merits of Cast-Iron, Wrought Iron and Steel Pipe for House Drainage Purposes.* Wm. Paul Gerhard. (3) Jan.
Rideau River Intercepting Sewer, Ottawa.* L. McLaren Hunter. (96) Jan. 2.
Four Methods of Sewage Treatment Studied at New Haven Testing Station. A Winslow and F. W. Mohlman. (13) Jan. 2.
Fine Screens and Chlorine Meet Daytona Condition. George W. Simons, Jr. (13) Jan. 9.
Rosedale Creek Sewer Extension, Toronto.* (96) Jan. 23.

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* Illustrated.

**Sanitation—(Continued).**

Light and Heavy Equipment Compared on Identical Sewer Construction.* Ralph H. Burke. (13) Jan. 23.
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# PAPERS AND DISCUSSIONS

FEBRUARY, 1919

Vol. XLV. FEBRUARY, 1919. No. 2.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

# PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications.

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## ADDRESS AT THE ANNUAL MEETING JANUARY 15TH, 1919.

By Arthur N. Talbot, President, Am. Soc. C. E.

If the President's address had been given at an Annual Convention, as the Constitution prescribes, a theme of greater entertaining value might have been chosen, but at the Annual Meeting it seems fitting to review some of the happenings of the year and to discuss the outlook for the Society.

### War Service.

The year has seen the nation engrossed in the great World War. As engineering and the engineer have played a vital part in war activities, it was to be expected that the membership of the Society would take an active and responsible part. The summary of the Society Membership serving in the armies and navies of the United States and its allies, as reported in the *Proceedings* of the Society, is indeed a glorious record. A grand total of 1 640, ranging from major-generals and rear-admirals down through to the ranks, with a very high percentage in the positions of great responsibility, tells a story of active patriotism. To this should be added the large number of members who, at a sacrifice of financial and home interests, have given up their time to governmental and war activities in a civilian capacity, and others who have taken responsibilities in war service in various ways. The response made by the engineer and the service he has given prove that he has attempted to do his part in full measure.

The achievements of the engineer in war activities here at home are greatly to his credit. The incomplete accounts of the work of the American engineer on the soil of France at points of debarkation, on lines of communication, and at the front present a wonderful story; and the award of the Distinguished Service Cross and the French Croix de Guerre to many of our members tells of their great valor on the field of battle. Nor can we forget the many who sacrificed their lives in this great struggle—their's will be bright stars in the flag of humanity. We rejoice that right has prevailed, even at a great cost of effort and of lives. We trust that the conditions of peace settlement will be a guaranty of the future rule of justice and democracy.

## Membership.

Notwithstanding the distractions occasioned by the war and the call of engineers to army and government service at home and abroad, the growth of the Society has been about equal to the average of recent years. The total membership on December 31st, 1918, was 8 933. As has been the case each year for several years, the number of Juniors has decreased during the year, the transfers to higher grades and the losses by death, resignation, and dropping being greater than the accessions.

Although the growth of the Society has continued regularly for many years, it may be noted that the total membership is exceeded both by the American Institute of Electrical Engineers, with a membership of 9 668, and the American Society of Mechanical Engineers, with a membership of nearly 10 000. Rapid gains have been made by these two societies in recent years. It may be noted that some societies, including many local societies, have secured large increases through membership drives, while the policy of our Society has been, not to encourage membership campaigns, but, instead, to accept the smaller but steady and substantial growth which comes without solicitation, in the belief that this method gives character to the Society and is productive of its best development.

## Financial Matters.

Although the expenditures properly chargeable to the work of 1918 are considerably less than the Society's income for the year, the treasury is low. There are a number of reasons for this. The cost of the alteration of the Fifty-seventh Street property has taken about

$18 000 in addition to money secured on the mortgage of the property. As there was no income from the property until late in the year, the interest on the mortgage was an added expense. The annual charge to the Society for space in the Engineering Societies Building, together with the Library assessment, amounts to about $10 000 more than corresponding expenses in the old location. Rising prices have also affected expenses. The remission of the annual dues of many members in war service reduced the income for the year. It will be recalled that although a balance was reported a year ago, the printing and binding of the *Transactions* for 1917 had not been paid for. Available funds had been used in completing the payment of the Society's share in the extension of the Engineering Societies Building, and this is the real cause of the deficit. Efforts have been made during the year to keep down expenditures and to restrain activities. In a general way it may be said that, leaving out of consideration the alteration of the old Society House, the income for the year has been about $14 000 more than the expenses, and that, if the bill for printing and binding the 1918 volume of *Transactions* is considered and the special funds taken into account, the deficit on January 1st may be called $20 000, counting the advance dues collected as income for 1918.

### The Fifty-seventh Street Property.

It will be recalled that it was announced a year ago that the property of the Society at 220 West Fifty-seventh Street, which had been the home of the Society for twenty years, had been given over temporarily to the use of the New York Federal Food Board without charge to the Food Administration, except for the cost of maintenance of the building. It seemed desirable to make the property a source of revenue, and this involved changing the building from a society house to a business building. The remodeling has gone on since August, a lease for a term of ten years has been executed, and the building is now occupied by a responsible business firm. It is expected that the net annual returns from this property will be in the neighborhood of $10 000, not counting renewals and depreciation. The property itself is estimated as worth upwards of $400 000, and there is an encumbrance of $200 000. The value of land in that part of New York City is said to be rising rapidly.

### The Engineering Societies Building.

The Society has now occupied its quarters in the Engineering Societies Building for more than a year. The work rooms of the office force have been found convenient and satisfactory. The reading room has been maintained and made attractive for members. The Society Library was merged with the Engineering Societies Library, and the library facilities of members are in reality greatly enhanced.[9] The Society contributed as its share of the cost of the enlargement of the Engineering Societies Building the sum of $262 500, the whole property now being estimated as having a value of $2 500 000. Removal to the Engineering Societies Building has brought new associations, and particularly a closer association with the other Founder Societies. From every side come expressions of approval and satisfaction. In joining quarters with the other societies it is felt that a forward step was taken in extending the influence of the Society and the profession of engineering. It is not too much to hope that the coming together in the one building will prove to be a forerunner of many mutual undertakings and of much co-ordinated and co-operative work, all helping in extending the influence and promoting the solidarity of the profession.

### Meetings.

An effort has been made during the year to get away from the usual programme of engineering papers, and, as far as possible, to give at the semi-monthly meetings matters relating to war activities. A number of interesting talks and addresses were given by American engineers and army officers, as well as by British and French officers. Naturally, the proper conduct of a war imposes restrictions regarding giving publicity to war activities, and on this account important war developments of engineering interest were not available for the use of the Society. An important development in the conduct of the meetings of the Society was the creation of a New York Meetings Committee charged with the conduct of the second meeting of each month. This act gives resident members a responsibility and an opportunity to make this particular meeting of special interest to local members. It is hoped that the movement will prove to be of great significance to the Society. Because of the war the Annual Convention was again abandoned.

### Publications.

With the progress of time the war has absorbed more and more of the energy of the country; this condition has been reflected in the Society's *Proceedings*. As a measure of economy, also, the publication of papers has been curtailed. Six papers only were printed in the first half of the year; only discussions of papers have been given in the last half. On the other hand, the space devoted to announcements, items, and reports has been increased, and an attempt has been made to include more and more items of interest to members. The *Transactions* for 1918 are in press and will be issued soon.

### Special Committees.

War conditions are not favorable for technical committee work. Committee members have been engaged in a variety of war activities, and, with all the distractions of the year and the scarcity of assistants, it would not be strange if the reports indicate less than normal activity. With the return of peace conditions it may confidently be expected that the Society's activities through its special committees will assume proportions in keeping with the opportunities which this agency gives for advancing professional knowledge and improving the standing of the profession, which should mean an expansion of committee work.

### American Engineering Standards Committee.

A matter of great possible significance is the formation of a permanent organization, known as the American Engineering Standards Committee, to carry on the important work of co-operating in engineering standardization throughout the entire field of engineering standardization. The organization has been formed by the following societies: The American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, with three representatives from each of these societies and from each of the following United States Departments: Commerce, War, and Navy. Other societies and bodies may be allowed to co-operate in the work, by becoming "co-operating societies", but are not to have representatives on the Standards Committee. The procedure for formulating standards is somewhat com-

plicated. Any interested organization may propose the development or revision of engineering standards in any engineering field, and, if the Standards Committee approves, it will designate one or more of the co-operating societies as sponsor or joint sponsors for the standard under consideration, and give the sponsor authority to organize a special committee, to be known as a sectional committee, to carry on the work. Sectional committees dealing with standards of a commercial character (specifications, shop practices, etc.) shall be made up of representatives of producers, consumers, and general interests. Special committees dealing with standards of a scientific or non-commercial character shall consist of persons specially qualified, without regard to affiliations. The special committees will report their recommendations to the sponsor and the sponsor, on approval, to the main Standards Committee. The Standards Committee may then approve the proposed standard as "Recommended Practice" or as "Tentative Standard", and when, in the opinion of the Standards Committee, after approval by the sponsor, it has proved its suitability, the Standards Committee may constitute it an "American Standard."

It will be seen that the organization may deal with standards and specifications in the whole range of engineering: materials such as steel, timber, cement; articles such as beams and structural parts, rails and ties, water pipe, machine parts; methods of work such as road building, concrete making; governmental requirements such as building regulations, requirements for working stresses, regulations for fire-proofing; scientific standards, such as methods of testing, standard technology, requirements for water supply; and specifications and standards of hundreds of kinds. It thus offers great possibilities for usefulness, and there are sources of danger. It is also to be seen that the formation of this organization may take from the Society opportunities for independent action on some matters. If the American Society of Civil Engineers handles its part in this organization vigorously and wisely, it will prove an opportunity for service to the profession and the public. If it does not care to be active in the matter, the field will be taken by others.

### Engineering Societies Employment Bureau.

On the initiative of the Board of Direction of the Society, an Engineering Societies Employment Bureau has been established by

United Engineering Society, with the Secretaries of the four Founder Societies as the Board of Managers. It is believed that this plan will prove helpful to members and to others.

### United Engineering Society and Related Organizations.

The past year is the first full year in which the Society has participated in the co-operative activities of the Founder Societies, and it may be well, therefore, even if a repetition is made of information published elsewhere, to review briefly the organization and functions of United Engineering Society, Engineering Council, Engineering Foundation, and other related organizations of the Founder Societies. Since the Society is participating in the work of these organizations and has given over to them some functions formerly carried on within the Society, the activities of these organizations should be considered as part of the work of the Society. United Engineering Society is the central organization. The related organizations, such as Engineering Foundation, are established and maintained through or by the United Engineering Society. United Engineering Society, is the holding corporation for the real property; it holds the title to the Engineering Societies Building. United Engineering Society also holds the title to such trust funds as may be contributed for the special purposes of the related organizations. United Engineering Society maintains the building and determines the apportionment of the budget among the several Founder Societies and the associate societies which occupy space in the building. It may establish departments or related organizations. United Engineering Society is thus the business and co-operating corporation which acts for the four Founder Societies. The governing board is the Board of Trustees, which consists of twelve members, three being selected by each of the Founder Societies.

United Engineering Society maintains and conducts the joint engineering library through the Library Board of twenty-one members, composed of the Director of the Library, the Secretaries of the Founder Societies, and sixteen other members, four being designated by each Founder Society.

The department known as the Engineering Foundation was established for the furtherance of research in science and engineering and for the advancement in any other manner of the profession of engineering and the good of mankind. The control and administration are placed in

the Engineering Foundation Board which is composed of the President of United Engineering Society, *ex officio,* and the following members elected by United Engineering Society: one trustee of the United Engineering Society from each Founder Society, two members from each Founder Society, nominated by its governing board, and three members at large.

Engineering Council was established "* * * in order to provide for convenient co-operation between the four Founder Societies, for the proper consideration of questions of general interest to engineers and to the public and to provide the means for united activities of common concern to engineers. * * * The Council may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers, unless objection be made by a majority of the representatives present of one of the Founder Societies or by one-fourth of the representatives present and voting," which is the phraseology of the By-Laws of United Engineering Society. It has been the general understanding that Engineering Council was formed to undertake, not the technical activities of professional societies, but rather the non-technical, semi-professional, and general work, and especially that which bears upon public interests and public affairs. At a recent meeting, Engineering Council, in an effort to define its field, declared by resolution as follows:

"That Engineering Council understands its fields of activity to be approximately as follows:

"(1) Council may deal with any matter of general interest for which joint action of two or more of its member societies would have been appropriate, if Council had not been established.

"(2) Council may initiate and carry through projects of the general character defined in the by-laws, for which the necessary financial provision has been made; but Council shall not undertake expenditures in excess of appropriations for its uses made by United Engineering Society on behalf of the Founder Societies and the contributions from other member societies, unless specific provision shall have been made therefor by subscription, donation or otherwise; moneys received by Engineering Council shall be turned into the treasury of United Engineering Society and disbursed by it, for the purposes designated.

"(3) Council may take up, and in its discretion act upon, any matter of general interest referred to it by any member society or by any other society—national, state or local—or by any branch of Government, or by an individual or group of individuals."

It further declared:

"Engineering Council will, as a rule, avoid considering any matter which is specifically within the province of only one member society and not of others."

It is evident that Engineering Council has broad powers and responsibilities in the co-operative field.

It may also be proper to make note of some of the activities and accomplishments of these organizations. As the addition to the Engineering Societies Building was completed in 1917, the work of United Engineering Society has been the maintenance of the Engineering Society Building and the carrying on of relations with the Founder Societies and the related organizations. At the beginning of 1918 an important change in organization was made by the engagement of a Permanent Secretary who also acts as Secretary of Engineering Foundation and Engineering Council. Alfred D. Flinn, M. Am. Soc. C. E., the Permanent Secretary, entered upon his duties on January 1st, 1918.

The Engineering Foundation was organized in 1916 when Mr. Ambrose Swasey, of Cleveland, Ohio, Past-President of the American Society of Mechanical Engineers, offered the United Engineering Society $200 000 as the nucleus of an endowment "for the furtherance of engineering, for the advancement of the profession and the good of mankind". This was a magnificent gift for a great cause—the advancement of engineering and the good of mankind. This eminent engineer, however, did not rest content with one contribution, but in September, 1918, he added $100 000 to the endowment, making the total $300 000. It is confidently expected that the good example set by Mr. Swasey will be followed by contributions from many other persons—engineers and others—including the smaller contributions from those who cannot give large sums, as well as princely gifts from those of large means.

The income from the present endowment, of course, would not permit the Engineering Foundation to undertake engineering research itself on any considerable scale, for the carrying out of the larger engineering research activities requires large sums for successful accomplishment, and the engineering field is very large and the problems are very numerous. The Engineering Foundation wisely decided to devote its main effort for the present to activities which would serve to

encourage, direct, and develop research agencies and activities, at the same time giving such aid to research work as is found practicable.

The possibility of the United States being drawn into the World War brought about, in the summer of 1916, the organization of the National Research Council, an organization of scientists, engineers, and educators. The Engineering Foundation saw the needs of the organization for funds, and contributed facilities and money until Government support became available for the work. Thus started, the organization became extremely helpful to the Government in the prosecution of the war. Finally, it became the Department of Science and Research of the Council of National Defense, and, by executive order of May 11th, 1918, it was permanently established in its useful work. The Engineering Foundation was very helpful at a critical time in thus assisting in an important movement for stimulating research, and thereby rendered the greatest possible service to the country at the time. With the co-operation of Engineering Foundation and the National Engineering Societies, the National Research Council early formed an engineering committee, which later became the Engineering Division and has the following aims:

"To carry out the general purpose of co-ordinating the scientific resources of the entire country as regards engineering and to secure the co-operation of all engineering agencies in which research facilities are available."

The Engineering Foundation and the American Society of Civil Engineers have representatives on the Engineering Division. The Engineering Foundation has continued to affiliate with the National Research Council in various ways, as, for example, in collecting information about the several hundred industrial research laboratories existing in this country and in helping to stimulate industrial research.

It would give a wrong impression if reference were not made to a number of instances of stimulation of research on special problems by small grants of money, such as for the investigation of the secret selective control of wireless communications, the wear of gears, weir measurements of water, and a proposed method of camouflaging vessels. Generally, however, Engineering Foundation is proceeding on the policy that its resources should be devoted to large enterprises and the solution of problems of broad application, rather than to detailed investigation of limited problems. The opportunities of Engineering

Foundation in helping in the advancement of engineering are abundant, for the advancement of the art of engineering is dependent on scientific research, and the standing of the engineering profession as a profession will be markedly affected by its attitude toward research.

Engineering Council has started out on important work. Considerable attention has been given, since its organization meeting on June 27th, 1917, in exploring its proper field of activity, in deliberating on what it may and may not undertake, and what it should and should not undertake—important questions for a body which is starting on undeveloped territory. At the same time, it has gone ahead with activities. Through the American Engineering Service, which it organized for war-time service, it rendered aid to the Government, resulting in procuring thousands of engineers for the war, navy, and other departments. Through the War Committee of Technical Societies, assistance was given the Naval Consulting Board and the Army General Staff in examining thousands of suggestions for naval and military devices. The names of the committees of Engineering Council at work indicate in some measure present or intended activities: Public Affairs, Fuel Conservation, Patents, Industrial Affairs, Water Conservation, for all of which progress is reported. At different times Engineering Council has been represented at Washington in respect to matters of interest to engineers, and its activities there have borne fruit. It is organizing a National Service Committee to give instant, active, and constant representation of engineers at Washington, especially on matters relating to reconstruction affairs. Engineering Council is endeavoring to keep in communication with communities of engineers all over the country. The preliminary work of organizing its activities has made considerable progress during the year. Engineering Council has an important task in attempting to provide for consideration of matters of common concern to the profession.

It will be agreed that the aims and functions of United Engineering Society and of these co-operative agencies are of far-reaching importance to the American Society of Civil Engineers and its membership. Their opportunities and responsibilities are indeed large.

### The Award of the John Fritz Medal.

The profession of civil engineering has been recognized and honored through the awarding of the John Fritz Medal to a prominent and

distinguished member of the Society, J. Waldo Smith, for his most distinguished service in engineering and great achievement as engineer in providing the City of New York with a supply of water. The public presentation was made at a meeting which took the place of a regular meeting of the Society. It is worthy of note that, in the fourteen times the medal has been awarded, this is the second award for what in the narrower sense may be called strictly civil engineering achievement, the first recipient being the late Alfred Noble, Past-President, Am. Soc. C. E.

### A Mission to France.

Responding to an invitation extended to the Society by the French Society of Engineers, with the approval of the French Ministries of Public Works, of Commerce, and of Armament, to send a small delegation of engineers to meet in joint engineering congress in Paris for the purpose of discussing technical matters relating to reconstruction work and the utilization of commercial ports, the development of navigable waterways, the development of water power, the improvement of road systems, and of other engineering and industrial interests of France, six representatives of the Society were chosen, who, with three representatives appointed by the other Founder Societies, sailed for France early in December, and are now engaged in sympathetic assistance in the consideration of important problems related to the future development of the resources and opportunities of our sister republic. The State Department sanctioned the going of the mission, in the belief that its presence in France would be taken as evidence of America's desire to make real the ideals that have triumphed in the war. The matter is significant, not only because it gives American engineers an opportunity to be of service to the engineers and people of France, but because of the opportunity it gave the Society to extend to the other National Societies an invitation to participate in a matter of general interest, an action which has been accepted by the other societies as an evidence of our desire to co-operate.

### The Committee on Development.

At its June meeting, the Board of Direction took a step which it is hoped will have significant and far-reaching results in the development of the Society and in increasing the usefulness of the engineering profession—the creation of a committee to report on the purposes, field

of work, scope of activity and usefulness, organization, and methods of work of the American Society of Civil Engineers—the purport of the resolutions being amplified by the preamble. The method adopted for selecting the committee gives a wide geographical distribution and an opportunity for the representation of local views. The Committee on Development held its first meeting in Chicago in November, spending three days in the discussion of its work. The preliminary report of the committee has been sent out to the membership. Sub-committees are at work on the development of the subject, and doubtless they will find a large task ahead of them. To prepare a final report adequate to the problems set before the committee and worthy of so great a cause will take long hours of work, much thoughtful deliberation, and the highest constructive powers. Let us give our full support to the Committee on Development in its labors.

It is worthy of note that the three other Founder Societies have appointed committees to undertake the same kind of an inquiry.

### The Work of an Engineering Society.

It would be presumptuous to attempt to forecast the outcome of the work of the Committee on Development. It seems proper, however, to try to bring to your attention this morning, in so far as the time will permit, some of the matters which appeal to me in studying what should be undertaken by the American Society of Civil Engineers.

What are the purposes and functions of an engineering society such as the American Society of Civil Engineers? In discussing this question, it is necessary not to restrict ourselves to the purposes given in the Constitution of the Society, which may merely follow precedent or may be worded to conform to a State statute governing the charter of the Society. Whatever may be our views of details, may it not be agreed that at least the following should be involved in a national engineering society:

A learned society; a collector and disseminator of engineering knowledge; a forum for the discussion of engineering questions, simple and complex, small and large; a stimulator of research and of the progress of engineering science; a developer of engineering methods and practice; an active force within and without professional circles; a creator of engineering policies and an originator and patron of constructive and progressive movements in engineering; an opportunity

for meeting and knowing the engineers of the country; a means of mutual helpfulness and co-operation for the profession and its clientele; an instrument for advancing both professional interest and public welfare; an agency for discussing the various phases of public problems and for participating in the service which all thinking organizations should give to society.

And the engineering society has justified its existence. It has helped to create the engineering profession. Its accomplishments, technical and extra-technical, all redound to its credit and to the credit of its membership. To recount the activities and achievements of the engineering society, within its walls and in service to the public and to society, in matters that are known to all, and in ways that are not usually recognized, would consume much more time than is available here. And the engineering society has given *esprit de corps* to the profession. It has made its members feel self-respecting. It has called to the attention of many the high standards held by the profession and the responsibility attached to membership in it. It has continuously raised the standards and the standing of the engineering profession, and has assisted in establishing this standing in the eyes of the public. The members who put the most into their membership relations get the greatest benefit, but the inactive member, perhaps unconsciously, profits by its beneficent influence, for there are intangible benefits and advantages which come from the presence and activity of the engineering society.

All this is accepted without argument in an audience such as this. The question up for consideration is what should be done to extend the usefulness of the engineering society and to make it a greater force for its membership, the profession, and the public.

## Technical Activities.

The technical side of the activities of an engineering society is of prime importance. Engineering is and must continue to be a technical art, a technical business. Its body of technical matters is far larger and more important than existed a generation ago, and the requirements for technical knowledge in engineering work are increasingly important. By technical matters are meant more than mere mathematical methods and the routine work of engineering; all the relations to the science and art of engineering in and out of professional circles are included, and

also the technical features of the business side and the technical relations with the public. Important as is the administrative and executive side, the characteristic and determining feature of engineering is the technical side. The time is past when ingenuity, rule-of-thumb methods, and workmanlike skill alone will make an engineer. If engineering is to be only a combination of business and routine construction, it becomes a craft, a mere line of business. The engineering society should be a principal factor in the development of the science and art of engineering, in developing and recording the technical side of engineering, the scientific substructure, the overlying elements of practice, the variform connections with business life. By the technical side is here meant, not alone a knowledge of engineering principles and facts; it involves creating engineering policies, developing engineering practice, improving and controlling engineering connections with the outside business world. To carry out its technical functions properly is a high aim for an engineering society.

One of the methods of carrying on this technical activity has been through the presentation and discussion of papers and publications on engineering topics. The contributions of the Society in this direction have been of great importance. It would seem worth while, however, to raise the question whether the Society is doing all it should do in this direction. Is there not need for papers in fields not often taken up in the Society *Transactions?* Should there not be more short, terse papers, devoid of details, which should stimulate and set engineers to thinking? Would it not be possible and desirable to have more papers dealing with principles, with the advances of engineering, with new methods and requirements? May it not be worth considering whether we should hold to the long-used policy of limiting ourselves only to those papers which are offered to the Society from time to time, regardless of whether this policy leads to ignoring large fields and results in transferring to other societies and agencies activities in these lines; and, aside from papers, are there not opportunities for dissemination of knowledge which may properly be undertaken—like reviews of engineering construction and methods, digests of important engineering literature, which seem now not to have adequate expression through other agencies?

### Work of Technical Committees.

Technical committees form one of the most effective means of carrying on the technical activities of an engineering society. Such

committees are able to utilize the experience and ability of many members and to take advantage of facilities and opportunities afforded by outside organizations. They can co-ordinate and unify practice, develop methods and recommend acceptable practice, acquire technical knowledge, formulate principles and standards, and recommend improvements and advances in the art. Their influence can reach out far beyond the bounds of the Society. Experience shows that committee work may be a power for good. Two of the specialized engineering societies of national character carry on the larger part of their work through committees. The American Railway Engineering Association has 23 technical committees, with a combined membership of 480 out of a total membership of 1 300 in the Association. The subjects for these committees range from ballast and rail to economics of railway operation and economics of railway labor. The American Society for Testing Materials has 38 technical committees and 144 sub-committees, with a combined membership of 1 094 out of a total membership of 2 300. Committee A-1 on Steel, which has had great responsibilities in the past few years, consists of 121 members. The membership of both of these societies gives a great amount of time and attention to committee work. The influence of the work of these two societies has gone out far beyond their membership, far beyond the limits which the names of the subjects would seem to make possible. At the risk of seeming disloyal, the opinion may be advanced that in influence on engineering practice, in effect in the industries, in influence on relations of engineering business, in advancement of engineering knowledge and the methods of manufacture and construction, and in influence in the outside business world, the achievements of these two specialized societies in the past few years have been such as to make some of the National Engineering Societies look to their laurels for leadership. It may not be too much to express the belief that the Committee on Development will find the need and opportunity for technical committee work an important subject for study.

### Specialized Divisions or Sections of the Society.

What seems to be an opportunity for energized activities lies in the formation of specialized divisions or sections of the Society to give attention to special fields of work, such as railway engineering, structural engineering, and hydraulic engineering. Members would enroll in sections in which they are interested. Sessions and conventions

would be held to discuss matters of common interest. The railway engineering division might hold membership in and co-operate with the American Railway Engineering Association, giving attention to certain features of the convention and committee work of that society. Another division might affiliate in some way in the work of the American Society for Testing Materials—in fact there is an unoccupied field closely allied to the work of that society. A division interested in sanitary engineering might find a welcome with the American Public Health Association. The activities of such specialized divisions would reach outside the membership and give new points of contact and influence over the outside world. New forces would be set up among the membership, and new opportunities for participation given.

### Formulation of Engineering Policies.

Both the committee work and the specialized divisions constitute effective agencies for creating engineering policies and originating constructive and progressive advances in engineering and related matters—important functions for an engineering society.

### Local and Regional Organizations.

In any discussion of National Engineering Societies it must be borne in mind that the membership is scattered over the country; that there are numerous centers of engineering, and that these are yearly becoming more important; that local engineering societies in these centers are essential elements in the life of the engineering profession; that these local societies furnish a means by which the young and growing man meets and knows other engineers and gains opportunity for development; that the National Societies may be greatly strengthened and their influence extended by closer affiliation with these local societies, and that any thorough consideration of the subject of aims and organization should endeavor to find ways and means by which the National Society may best effect closer co-operation with the local engineering society. It is also true that local conditions vary greatly, from place to place, over the country, and that the problems and the methods of contact with the public are far from uniform.

In the last few years there have been formed twenty-two local associations of members of the American Society of Civil Engineers (a term which I hope will be replaced by a less clumsy one such as

Chapter) at centers of engineering over the country. These local associations, if cherished a little, may be expected to be very active elements in the life of the Society. They should also become important elements in the life of the communities in which they are.

In many of the centers of population the local engineering societies are well established; in others they will become so. It would seem wise, in any attempt at organization of the profession throughout the country, for all the National Societies to join forces with these local societies in every possible way. In every center of engineering the local engineering society should be the basis of organization. Some plan should be devised, perhaps by increase of dues, to contribute revenue from the treasury of the National Societies to the Chapters for use in this union work with the local societies. It is evident that closer connection with the local engineering societies will promote loyalty in the National Societies. I believe some form of organization may be worked out which will win the support of the tributary membership and greatly strengthen both National and Local Society.

For certain purposes it may be found desirable, also, to have a regional organization, covering territory corresponding to districts, like those of the geographical districts used in the selection of the Nominating Committee, for handling matters of common interest over a region, a matter which could be worked out in connection with the management of the local associations.

In dealing with our distributed membership, the situation in New York should not be overlooked. The provision for a New York Meetings Committee to take charge of the second meeting of each month, made by the Board of Direction on the recommendation of the Secretary, is a step in advance. It would appear to me that, in any new plan for local associations or regional organizations, the resident membership (those within fifty miles of the New York City Post Office) should be granted some degree of autonomy, by the formation of a local association or chapter or otherwise, and that the New York membership should be set at work and stirred up to realize and utilize the opportunities and facilities at their door.

### Relations with Other Societies.

Intimately connected with the question of local associations and local societies is the question of our relation with other National

Societies. These relations are yearly becoming of greater import. The four Founder Societies have many activities in common. Engineering Council may soon have its membership increased by three more societies. The Engineering Standards Committee will have the co-operation of a number of societies, besides the four Founder Societies. The opportunities for co-operation are increasing. It is increasingly apparent that engineering is a single profession; the various branches ramify and merge into each other in numerous ways. Many engineers think there should be one large inclusive engineering society to take the place of the several National Societies—to be made up of the 35 000 engineers in the four Founder Societies or the 100 000 or 200 000 who may claim the right to be classed as engineers. It does not seem probable now that the immediate future will bring about such a single organization. In default of this desideratum, the best use possible must be made of existing agencies. Organization should be effected which will bring united effort along many lines. The further union of National Societies and their co-operation with the local societies of the engineering centers in developing engineering society activity are potential factors for the future. This, too, is a fruitful field for the Committee on Development.

### Relation to Public Affairs.

It has frequently been remarked that the engineer is likely to be confined so closely to his own work that his influence does not extend out as far as it should, and particularly that he has not taken part in public affairs, in governmental and economic activities, to an extent warranted by his training and business standing; and, further, that the engineering society has not accepted in full measure its opportunity and its responsibility in public and civic matters. To recount the accomplishments of the engineer in civic affairs, in governmental activities, in influence on public policy, in the solution of industrial problems, would show a creditable record; and the engineering society likewise has achievements greatly to its credit; but, notwithstanding all these accomplishments, it must be apparent to all that the engineer and the engineering society now have opportunities and responsibilities in the direction of public duty far beyond what they have hitherto considered as their share. This is especially true at the present time, when the successful solution of so many public problems lies within the province of the engineer.

The consideration of quasi public matters has not always been accepted as a proper field for Society activity. As an illustration, the opposition to the creation of a Committee on Valuation of Public Utilities may be recalled. When the Board of Direction was discussing the measure, a member opposed it because he felt strongly that the engineer should confine himself to the design and construction of engineering works, and another because valuation was not an engineering question and should be left entirely to the Courts, overlooking the service which only the engineer could give in correlating the engineering data and establishing principles to be considered in making decisions. Fortunately, the advocates of the appointment of the committee prevailed, in the end, and a magnificent report and discussion was given to the public, a report and discussion which doubtless will continue to be used and quoted whenever and wherever the valuation of public utilities is discussed by layman or Court. Besides, the activities of the committee stimulated thought and provoked discussion throughout our membership as few subjects have done.

How the engineer and the engineering society may best deal with public matters is a complicated question. The engagements of most engineers are not like those of the lawyer. There is a great diversity of condition of service and environment, even in the same lines of engineering, and the interests are very diverse. Evidently, a satisfactory plan may be evolved only after much study, and only a few of the elements of the situation may be touched upon here.

Part of the public work of an engineering society lies in bringing to the attention of public bodies technical and other matters already available through its committees and its publications, and in giving co-operation along lines where general technical information and direction will be helpful. Civic improvement and city planning, health and sanitary conditions of cities and communities, industrial conditions and their betterment, the need of high-grade engineering supervision of public work, are examples in one direction only. The public should be taught that there is a great body of knowledge, experience, and expert judgment the utilization of which greatly benefits mankind.

Certain matters of public interest are frequently considered through independent or auxiliary organizations, more or less temporary in character. The agricultural interests use such agencies rather freely. The

Reconstruction Congress of War Service Committees is a recent activity, held under the auspices of the United States Chamber of Commerce, to recommend what American business ought to do for the Government and what the Government ought to do for American business. Waterway conventions and drainage congresses are also examples of this method of work. Unless savoring too much of propaganda and special interests, the method of disseminating information, stimulating discussion, and influencing public opinion through special organizations, is effective and legitimate.

Direct connection with Governmental agencies may be difficult. Special instruments may need to be created. Great credit should be given to Engineering Council for the start it has made in handling public matters in this first year of its organized activity. Its recent creation of a National Service Committee, with an appropriation for expenses, for active and constant representation of engineers at the seat of the National Government, in these times when reconstruction problems involving engineering are at the front, is a very promising movement. It illustrates the type of work which the engineering society can undertake. A variety of methods will have to be used. Those public problems which are local, or are confined to States or limited territory, may be handled most satisfactorily through local or regional organizations.

It would be premature to try to outline here methods for accomplishing the great work in public matters which should be undertaken, or the form of organization which is needed. The formation of a large and representative public affairs committee has been suggested, and also a delegate convention organized to discuss matters of public interest and intended as a forum for voicing the sentiments of the organization. More than these are needed. So much time has already been taken in this address that I will not attempt to outline my views. Whatever is done must give opportunity for exercising initiative and providing powers for action. Leaders must then energize the machinery provided.

### Financial Considerations.

The activities here referred to will require adequate funds; it takes money to do things in this world. Our equity in the Engineering Societies Building, which seems a princely one, can never be a source of revenue, but must continue to be a large item of expense, however

much it adds to the standing and respectability of the Society. The present stringency in our treasury is believed to be temporary, and January, 1921, should begin with current expenses all paid and a balance in the treasury at least equal to the advance dues collected, together with such special funds as may have been contributed from outside sources.

It must be understood, however, that if the activities of the Society are to be extended, funds must be provided to pay the accompanying cost.

Part of this may well be taken from the annual balance of $20 000 or $30 000 which in normal years may be left after paying the expenses of present activities. It seems reasonable that a society which has become established financially should not continue to put aside from annual receipts very large sums as endowment; the increase in endowment may be expected to come from other sources.

Increase in membership will bring increased revenue beyond the accompanying expense. Many believe that there should be a considerable increase of membership.

With increased activities and higher costs for everything, it is possible that an increase in annual dues may be worthy of consideration.

The expense of some activities may be borne from contributions from various sources, probably a fruitful source of revenue for several lines of activity.

Much of the work which may be undertaken will be carried on by individuals and organizations—the Society's part will be to organize, stimulate, and direct.

If it is agreed that there are activities which the Society should undertake for the benefit of the profession and society, activities that will bring results and that will help in making the Society a force of greater and greater influence, who will doubt that resources will be found to finance the work?

## Conclusion.

Altogether, it is a great problem—one worthy of the best thought of the Committee on Development and the Society. To shun the visionary, impracticable schemes, and yet be not too complacent about past accomplishment; to seek to be national and not provincial; to try to be both democratic and efficient; to lead in the progress of the times and

yet to hold to the old and proven good; to work to be a powerful engine in technical affairs and a vital force in the life of the profession; to learn how best to give service to the community and the nation; to provide methods by which the profession may lead in progressive movements—these are ideals worth striving for in making a plan. It should be borne in mind, too, that elaborate or complicated organization is likely to be ineffective; the machinery is not self-propelling. Mere paper proposals will not suffice. Whatever is done, we must keep down on earth, accept only workable plans, but still not be content with stagnation or mediocrity. It is my belief that a plan may be worked out befitting the needs of a great profession, and that, with such a great opportunity before it, the Committee on Development will evolve a plan satisfactory to the Society. The discussion of the whole question will serve to stimulate interest, improve spirit, and arouse latent vitality. May we not expect that the result will be a stronger, more useful, more virile Society? As members we confidently look forward to a great future for the American Society of Civil Engineers.

AMERICAN SOCIETY OF CIVIL ENGINEERS

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PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications.

# THE NATIONAL RAILROAD QUESTION OF TO-DAY.

An Address Before the American Society of Civil Engineers February 5th, 1919.

By Francis Lee Stuart, M. Am. Soc. C. E.

For an understanding of the Railroad Question of to-day it is necessary to review the facts which led up to Federal Control of the Railroads.

As one who had a hand in the development of several trunk line railroads with Ocean Terminals and has been otherwise connected with the Railroad subject in many ways, the important facts as I see them are:

For ten years before the war the clashing of State and Federal laws, the effect of the Laws under which the Interstate Commerce Committee worked or their interpretation of such laws gave indication that the railroads of the country, while in a high state of efficiency, were losing their attractiveness to investors, and many were losing their financial strength, so that the war found most of the railroads with small surplus in hand for meeting an emergency.

Early in our entrance into the war it became evident that the rush of material to the seaboard by all the unrelated efforts of the various departments of our Government and of the Allies, could not be handled by the shipping available, and that the physical and moral burden would fall on the railroads of the eastern section of the United States until

proper organization could be set up in the War Department to take care of the situation.

The eagerness with which every interest pressed the loading of cars, regardless of whether there was a prospect of prompt unloading of cars or not, and the inefficiency of the railroad embargoes began to congest the tracks, cars, and other facilities of the railroads bringing with them their train of consequences, all of which tended to lessen the earning value of the properties; and, in addition, the buying power of the unit of value for which transportation service was paid rapidly began to depreciate, causing conditions which if prolonged would make a crash inevitable before the public could understand the real trouble and remedy it.

With our restrictive railroad policy, in order to save the transportation means of the country while it was still an efficient agent for winning the war, some Governmental aid had to be extended to tide over the situation. This aid finally took the shape of an Act of Congress, and the railroads were taken over under Federal control for the duration of the war and twenty-one months.

A Government agency equal in power to any other Government agency issued orders that cars were not to be loaded unless there was a definite arrangement for unloading; demurrage charges were increased and enforced; public opinion gave its moral support to orderly methods; the Government assumed the financial burden; and the railroads, as soon as the exceptional weather conditions of the first two months of Federal control permitted, with the same staff and the same equipment, began to function satisfactorily for war purposes.

A standard return was guaranteed for the use of the railroad plant; rates were raised so that the cost of transportation of the day should pay its way; wages were raised to meet the depreciating value of the dollar; and, in addition to those three vital essentials for handling the situation, the American practice of detouring and the placing of effective embargoes to avoid congestion was used on a large scale, and there was an insistence for a commercial business policy which provides a storage for unloading cars promptly to avoid the use of cars as a storage medium, all of which helped the transportation effort.

Under existing laws it was necessary for the railroads to be taken over for the winning of the war, and they were directed by the Director General of Railroads, for the President, with the single purpose of

making them efficient transportation agencies for winning such war, and the war is won.

The cost of a war must always be excessive, for obvious reasons, and there can be but little criticism of such actions as have been taken by this country, for when a republic is at war the resources of the nation should be utilized for the purpose of winning the war. Economic considerations, material and personal, must be disregarded when they interfere with that singleness of purpose.

It is best that the Governmental action of a republic at such a time should be as free as possible from criticism during the period of danger, and legitimate criticism can wait until time permits an analytical and impersonal investigation as a basis for criticism for the purpose of educating the republic in case of such a future emergency.

While on the subject of criticism, let me suggest that, although it may not be advisable to advocate that we draw a veil over all the acts of the war, yet we are all too prone to criticize, and let us in justice remember that the men who are responsible for getting our preparations under way and for the stupendous scale upon which we proposed to carry on the war, are the same kind of American Public School boys you and I are, and that we would probably not have done much better. And let us further console ourselves for our taxes with the thought that no one can tell what real effect the very scale of our effort had on the morale of the Germans, and how many thousands and tens of thousands of lives may have been saved thereby.

The war is won; the readjustment problems are serious, but, grave as they are, conditions are changed, and the happiness of the people and the due consideration of the economics of the country have become the paramount duty of the Government in solving these problems, and there is no reason why our re-adjustment problems should not be fully discussed.

Very fortunately for the country, an unusually able staff was selected for the United States Railroad Administration, but the fact remains that Federal Control of all the railroads as one road, with the best intentions and with bright minds giving their earnest thought to the Federal problems, while it has taught the country at large, and the owners, valuable lessons, which are worth all it has cost, has developed nothing of real material moment which it is desirable to perpetuate in peace times, or which has not been practiced under

private ownership, or cannot be more effectively practiced under private ownership.

The railroad question of to-day is what shall the Government do with the Railroad? Government ownership or Government control for five years, or a return of the railroads to private ownership as soon as possible?

### Government Ownership.

Politics has no conscience, business morals, or responsibility, and the danger to our methods of government from the political control of the railroad employees, possible and probable, from Government Ownership prohibit its serious consideration.

From an engineer's standpoint, this country is young, and its natural resources have hardly been scratched, and an experiment in Government Ownership would be extravagant, unfortunate, and undesirable on any basis, but primarily because it destroys the reward for initiative and sound judgment in the greatest field necessary for the proper development of our country and our national prosperity.

From the public's point of view, Government Ownership throttles competition, which is a necessary incentive for proper service to the people in every part of the country and every city in the land.

### Control for Five Years:

Some of the things which were ordered with propriety during the war, which should be undone at once and not five years hence, are:

The Traffic Departments of the various railroads, which were dispersed, should in great part be re-assembled and re-habilitated at once. Such departments are as necessary in dealing with the public for the sale of transportation as the advertising and selling departments of any other business, and can be of great service to the public in many capacities.

An immediate abandonment as a national effort of an attempt at standardization of all manner of railroad necessities and methods. Such standardization, while it has a certain apparent first-cost economy when applied to quantity productions in the scheme of things in this country, tends to inefficiency, and should be a local question only in a limited locality. Our tools and methods are so crude that the national efforts should be to improve, not to standardize.

The horizontal raise in railroad wages of the entire country in one order which was necessary during the war is a pernicious destroyer of individual discipline, and atrophies the ambition of the men receiving such increase, and should be abolished in time of peace for responsible bargaining between employers and their own employees as soon as possible.

The discomfort of the public, some of which was necessary during the war, should give way to even better facilities than offered before the war, the direct tax of an increase of passenger rates should be reduced to a minimum, even if an indirect tax of increased freight rates is necessary to pay the bills. The movement of the people freely around and about our country should be encouraged as increasing happiness and social well being, and tending to a unity of spirit which is good for the body politic.

The discontinuance of regional consolidation, which was necessary for operation during the war, and an immediate return to a competitive basis in all matters pertaining to service to the public.

The terminal problem, which was made so acute by lack of ships and storage facilities, is largely one of changing our commercial methods, pooling facilities, and providing for the prompt unloading of cars. Belt railroads are needed and should be built in many places, but the matter is a local one peculiar to each community, and best handled as a financial policy of such community and not by the Federal Government.

We have great national efforts to make in world affairs, and the sooner we put the vim of an owner's interest back of the largest business interest in the country the better.

## Return to Private Ownership as Soon as Enabling Legislation Can Be Passed.

This country is so young and undeveloped that the railroads should exist and be encouraged primarily for the development of our material welfare, and, for the good of all, the railroads should be returned to their owners as soon as possible so that their growth will naturally follow the normal business needs of the country tested by business standards and not directed into any pre-determined course which would be determined by a centralized Governmental agency.

Returning the roads to their owners under old conditions would bring financial disaster to insurance companies, savings banks, in fact, would mean financial chaos in the country; therefore, some legislation with certain Governmental controls is absolutely necessary.

The normal growth of our country requires that the railroads spend in the next five years at least four billion dollars for improvements, betterments, and normal growth of our transportation service, and a continuing and enlarging amount thereafter to meet our growing needs. While the Government finds it necessary to put out varying issues of Liberty Bonds, it seems best that they buy the securities of the Railroad as needed until the Public regains confidence enough to take the investment out of their hands. This will require a possible advance of from a billion and a half to two and a half billion dollars, for which the Railroads could be charged a high enough annual interest charge, over and above the cost of the money to the Government itself, to pay off the debt within twenty or twenty-five years.

It will take a stable continuing railroad financial policy to renew the confidence of the public in railroad securities, and it seems to me that the railroad interests of the country, which is the largest single interest, should write off all extraordinary war costs within a short generation and lesser business interests in less time—in fact, I think, to keep step with the age, the Government should find financial measures to write off and obliterate all or most of its national war costs within thirty to forty years or less.

The principle of a fixed financial policy and the control by the Government necessary to carry out such policy under all ordinary business cycles should be made a law by Congress. The control should be of an enabling nature and not more restrictive than is necessary, and might at the present time well consist of:

*First.*—A control of rates initiated by the carrier. The rate question is largely an artificial issue and little understood by the public. The shippers of the country are chiefly interested in rate relationships and the ultimate consumer in the amount of the rate, as he really pays the bill. We hear of the shippers through their lawyers, but the ultimate consumer is rarely heard, because his indirect tax due to the rate alone is so very small. There are possibilities in a more logical rate structure for settlement of most of the misunderstanding between

the public and the shipper, and between the shippers themselves, for which the railroads usually hold the bag. In connection with the control of rates, the Government should have an unbiased economic study made for a more logical application of rates than at present.

*Second.*—The wage question of the railroad employee, like other inflations of the war, will be settled sensibly by public opinion. It does not seem a proper Governmental function to settle wage scales, and it is for the best continuing interest of labor itself that such questions should be returned as soon as practicable to be settled between employers and employees. It is necessary, however, that the Government take cognizance of such matters in the control of rates.

*Third.*—A control of unproductive expenditures required by the public, and particularly as to the grade crossing elimination question which threatens to be of serious financial importance in the near future so that due cognizance may be taken of such expenditures.

*Fourth.*—A control of issue of securities for improvements and consolidations and of the necessary railroad accounts. Generally, the weak lines should be consolidated with the strong, and the large lines prevented from becoming so large that they eliminate competition from any section of the country.

*Fifth.*—A control in safety matters.

*Sixth.*—A recognition that for the continuing solvency of the properties the voice of the general public, whose welfare is at stake, and the voice of the owners of the properties, should be heard with that of the shippers and representatives of the employees.

In my opinion, the proper principles for legislation for a fixed financial policy should be based on an average railroad efficiently operated, receiving, as a minimum, a fair profit for the transportation it has to sell, and that fair profit must include:

1.—An adequate going return on the investment over the cost of proper service to the public;

2.—A return for such money as is borrowed for improvements required by the growth of the country, which will include the cost of the money plus an added equity to the corporation in compensation for extending their credit and brains as collateral for such money;

3.—The further right to build up such surplus as this class of business, wisely conducted, should have in reserve for emergency.

Nothing short of such a financial policy under private ownership will bring investors back to the support of the railroads and keep up the healthy growth of our country. Nothing short of such a financial policy, under private ownership, will give the people of our country a healthy sense of freedom and the right to demand competitive service for their happiness, comfort, and material benefit.

The matter of return of the railroads to private ownerships on a basis of such a financial policy can be applied at once without an absolute determination of results before the policy is adopted. For a willing trader, the securities and proper earnings on the investments of the average railroad with the many years of a repressive public policy putting increments of values into the properties, should not be difficult to determine within safe limits. On any given rate, some roads will fail and others will prosper, from many different causes, but the extremes can be regulated to meet the political feeling of the times by the beneficent use of an excess profit tax.

With the principles of a policy fixed, and controls whereby it may be made effective, the means for carrying out the purpose could be more flexible, and could consist of a number of commissions with some coordinating force, all safeguarded in certain cases by right of appeal to proper courts.

The entire matter is of such importance to the whole country that, if this session of Congress cannot settle the question, then an extra session should at once be called for this purpose. It seems to me, it is the simplest of our re-adjustment problems, and the one needing the most immediate attention, and the one most important for the immediate welfare of the country.

# MEMOIRS OF DECEASED MEMBERS.

NOTE.—Memoirs will be reproduced in the volumes of *Transactions*. Any information which will amplify the records as here printed, or correct any errors, should be forwarded to the Secretary prior to the final publication.

## CLARENCE COLEMAN, M. Am. Soc. C. E.*

DIED OCTOBER 23D, 1918.

Clarence Coleman, son of the late Clayton Glanville Coleman and Sarah Macon Jerdone Coleman, was born at Jerdone Castle, Louisa County, Va., April 4th, 1849. His father was General of the United States Militia, before the Civil War.

Mr. Coleman was tutored at his home, as a boy, attended several private schools in his State, and then studied at the Virginia Military Institute and at Washington and Lee University, Lexington, Va.

When he was a very young man he was employed for several years (1870-72) by the Houston and Texas Central Railway in various capacities, from Rodman to Resident Engineer, on the location and construction of 200 miles of that road. Then, for 2½ years, he was engaged in private practice at Dallas, Tex. In 1875 he was Engineer of a geological survey for the Buffalo, Bayou and Colorado Railroad, and during the following five years was engaged in private engineering practice at Richmond and Kenmuir, Va. He served in 1881 as Assistant Treasurer of the Richmond Street Railway Company, and in the latter part of that year and in 1882 as Instrumentman on the Chesapeake and Ohio Railway.

He was Engineer of the Arminius Copper Mines Company, and the Sulphur Mines Company, both of Virginia, from 1883 to 1885, during which time he made surveys and installed a complete mining plant for the first named company, and built two branch railways from the mines to the main line of the Chesapeake and Ohio Railway. From May, 1888, until the end of that year, he was in charge of the construction of the terminal docks and transfer bridges of the Housatonic Railroad Company at Wilson's Point, Conn., and, in the same year, made an inspection and report on the company's bridges in Massachusetts.

For a little more than a year, in 1889-90, Mr. Coleman was Chief Engineer of the Santa Fé Southern Railway, and located 48 miles of mountain road over the Ortiz Range.

After a year's private practice as Consulting Engineer at Roanoke, Va., in 1890-91, he entered that city's service, first for four months as Building Inspector, then, for two years (February, 1892, to March, 1894), he was Engineer Member of the Board of Public Works, during which time a sewerage system was planned and built, and pavements and bridges were constructed. While in Roanoke he was a member of the Association of Engineers of Virginia, and in 1892 was elected President

* Memoir prepared by John H. Darling, M. Am. Soc. C. E.

of that Association. Two of his contributions to the Association bore the following titles: "The Engineer as a Factor in the Development of Virginia" and "What our Bad Roads Cost Us."

The foregoing record gives an outline of Mr. Coleman's work during the first period of his professional career as a civil engineer, which it is seen consisted mainly of railroad construction and municipal improvements, with intervals of private practice, all of which work was within the Southern States. His activities were now transferred to the northern part of our country, in the Duluth District, where he was engaged during the remainder of his life on Government harbor improvements, carried on by the War Department, with officers of the Corps of Engineers in charge of the District. He was appointed Assistant Engineer by Maj. Clinton B. Sears on November 27th, 1894, and continued to act in that capacity until November 23d, 1917, when he was made District Engineer. He held the latter position until removed by death.

Mr. Coleman's work in this district consisted mainly of marine concrete construction, in which he specialized. First, at Marquette, Mich., Harbor from 1894 to 1898, inclusive, he commenced the construction of a concrete superstructure to the old timber-and-stone breakwater, in accordance with a general design prepared by Maj. Sears, the officer in charge. In this construction the old timber with its rock filling was removed down to about 2 ft. below the water line. Concrete footing blocks, moulded ashore, were laid along the two edges of the timber cribs, and, between and above these, mass concrete was deposited in forms. A gallery traversed the entire length. After a considerable portion had been built, Mr. Coleman was transferred to Duluth, and the work was completed by other engineers.

At Duluth-Superior Harbor, in 1898-1902, he was in charge of the construction of the concrete superstructure for the new combined timber and concrete piers, or jetties, which define the entrance channel from Lake Superior to the north end of Duluth-Superior Harbor. In this case, as at Marquette, there were concrete footing blocks surmounted by monoliths of mass concrete. At the lakeward ends substantial pierheads were built for supporting light stations.

At the south, or Wisconsin, entrance to Duluth-Superior Harbor, also known as Superior Entry, Mr. Coleman, in 1903-09, built some all-concrete revetment piers, which were designed by himself, under the direction of Maj. D. D. Gaillard, Corps of Engineers, U. S. A. The main purpose of these piers was to serve as revetments at the two sides of the entrance channel for retaining the sand of the spit through which the entrance passed. In this construction, which is a departure from the usual types, there are monolithic sections or units, 16 ft. in length, moulded *in situ* around and on foundation piles sawed off a short distance above the level of the bottom, which had been dredged to a depth

of 21 ft. below low water. Specially designed removable forms and machinery for handling them were part of the rather expensive plant required for this work.

The construction of these revetment piers was the most original work accomplished by Mr. Coleman, and possibly the most important, also, when its value is considered as an example for similar constructions where conditions are favorable. It has been described in several technical publications.

Among other constructions in the Duluth District, in charge of Mr. Coleman under direction of officers of the Corps of Engineers, may be mentioned the following:

The project of a Board of U. S. Engineers for the further improvement of Superior Entry, approved April 5th, 1907, under which was built, in 1907 to 1912, two converging breakwaters, comprising 4 205 lin. ft. of rubble mould, 900 ft. of stone filled cribs with concrete superstructure for pierheads, and 896 ft. of concrete shore revetments; the dredging of a stilling basin within the breakwaters with an area of 35 acres (completed in 1915), and the dredging of a harbor basin of 98 acres (completed in 1914); the completion of a 1 500-ft. rubble mound extension to the Marquette Breakwater, in 1914-18.

Mr. Coleman was assigned to the charge of the Duluth District on November 23d, 1917, with the title of District Engineer, following the transfer to another post of Col. D. W. Lockwood, the officer in charge. He held this position until his death in the following year.

Mr. Coleman served in the capacity of Consulting Engineer on a number of private and corporation projects. Owing to his research and experience, he was considered an authority on concrete, and was often called in consultation on this subject.

He was married in 1873 to Miss Bena Randolph Philips, daughter of John Penn Philips, a prominent lawyer of Warrenton, Va., and Elizabeth Lewis Pickett Philips, who was a cousin of Gen. George Pickett, of Gettysburg fame. No children survive. Their union was a happy one, and their home was warm with true southern hospitality. Mr. Coleman was a good liver, and a cheerful disposition beamed from his face. His memory was stocked with a choice assortment of anecdotes and humorous stories, many of them in the negro dialect, which often aptly enlivened his conversation and spiced his public addresses.

He was fond of music, and played the violin in his home. He was a connoisseur of this instrument, and had a hobby for looking up and possessing a collection of old historic violins of rare quality and value which he took pleasure in describing to his friends. In religion Mr. Coleman was a Roman Catholic, and he and his wife were faithful members of that church.

His final illness extended over a period of four months. Its nature seems not to have been well understood, but hardening of the arteries was said to be the ailment. During the earlier part of his illness he

made brief visits to the office, and when unable to leave home he continued to transact necessary official business at his house. Thus he "died in harness", at the age of 69.

Mr. Coleman was elected a Member of the American Society of Civil Engineers on November 3d, 1897. At the time of his death he was First Vice-President of the Duluth Association of Members of the American Society of Civil Engineers.

## HERMANN LAUB, M. Am. Soc. C. E.*

DIED DECEMBER 10TH, 1918.

Hermann Laub, of Swiss ancestry, was born in Durmentingen, Wurtemberg, on April 14th, 1855, his family having moved there from Switzerland some years before that time.

At the age of twelve he entered the Preparatory School at Riedlingen, where, in addition to his mathematical studies, he took up English, French, and Spanish before entering the Higher Preparatory School at Biberach.

After pursuing the preparatory course at the Polytechnical School of Stuttgart for Civil Engineering, he was admitted as a full student, and was graduated as a Civil Engineer in 1879. He also pursued the course of civil engineering at the Munich Technical High School.

In 1880 Mr. Laub came to the United States, where he took a position in Denver with the Denver and Rio Grande Railroad. From 1881 to 1884 he was engaged in railroad location with the Mexican National and the Mexican Central Railroads. While connected with the Mexican National Railroad, he located a road from Salvatierra to Celaya, San Miquel, and San Luis Potosi. As Locating Engineer of the Mexican Central Railroad, he located a road from Tepic to Navaretta and San Blas, on the Pacific Coast, over some of the roughest country in Mexico. During his three years in Mexico, he located, in all, more than 500 miles of railroad.

At the conclusion of his work in that country, Mr. Laub went to Pittsburgh, Pa., where he accepted a position as Designer with the Schultz Bridge Company, in whose employ he remained from 1884 to 1887. Among the chief designs he made while with this company were those for the Junction Railway Bridge over the Allegheny River at 33d Street, Pittsburgh, the Indianapolis train-shed, and numerous other structures. In 1887 and until 1890 he associated himself with Gustav Lindenthal, M. Am. Soc. C. E., during which time the Smithfield Street Bridge and extensions were executed, and a bridge over the Monongahela River at Duquesne was built.

In 1890, Mr. Laub established himself in Pittsburgh as a Civil and Consulting Engineer, and from that time until his demise occupied

* Memoir prepared by A. L. Schultz, M. Am. Soc. C. E.

and enjoyed a high place in the Engineering Profession, having always the esteem and high regard of his clients.

In 1908 he was engaged on the reconstruction of the Homeopathic Hospital, at Pittsburgh, Pa.; and in 1910 he was called upon to repair, at great risk, the 22d Street Bridge, without stopping traffic for a single day.

For many years Mr. Laub was selected by the State of Pennsylvania as Bridge Engineer for the erection of numerous bridges throughout the State. He represented more than twenty bridge companies as expert Valuation Engineer during the period from 1909 to 1916 in condemnation proceedings for the sale of bridges to Allegheny County.

Mr. Laub's versatility enabled him to design various structures for special purposes, covering almost every form of industrial plant, in addition to long-span bridges of every design over the Monongahela, Allegheny, and Ohio Rivers, such as the McKeesport and Port Vue Bridge in 1909, the Brownsville Bridge in 1913-14, the Parkersburg, West Va., Bridge, in 1915-16, and the Norfolk Bridge in 1917-18, also, in 1914-17, the repair of the Hot Metal Bridge for the Monongahela Connecting Railroad over the Monongahela River at Pittsburgh.

Among the chief industrial plants constructed under his supervision were the Chambers-McKee Glass Plant, at Arnold, Pa.; the McKee Glass Plant, Jeanette, Pa.; the Oliver Iron and Steel Company (various mills); the galvanizing plant for the National Tube Company, the Rochester Tumbler Company, and the Federal Glass Company, at Cambridge, Ohio.

Mr. Laub was one of those generally robust, earnest, and untiring workers whose keen judgment was always gladly accepted. His general disposition showed a marked reserve, but to his intimates he displayed a lovable attitude. Mr. Laub was always in good health, so that his sudden demise from heart failure on December 10th, 1918, came as a shock to all with whom he was acquainted.

On November 27th, 1884, he was married to Miss Rosa Hauber, at Jersey City, N. J., and she, with two sons and two daughters, survives him. One son was in the service of the United States Navy at the time of his father's death.

Mr. Laub was elected a Member of the American Society of Civil Engineers on September 1st, 1897.

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## HENRY PRENTICE MORRISON, M. Am. Soc. C. E.*

DIED DECEMBER 17TH, 1918.

Henry Prentice Morrison was born in Troy, N. Y., on January 14th, 1857. At an early age he came to New York City with his parents and settled on the lower west side, where he lived for many years. He was

* Memoir prepared by Theodor S. Oxholm, M. Am. Soc. C. E.

educated in the public schools, and was graduated from New York University in 1880, with the degrees of B. Sc. and C. E. For a short time after his graduation he served as Assistant to Mr. George N. Harris, on the Baltimore and Ohio Railroad.

In March, 1881, Mr. Morrison entered the Department of Public Works of the City of New York, where he remained until 1893. During these 12 years he served as Assistant to the late Stevenson Towle, M. Am. Soc. C. E., in the Bureau of Sewers; in the Bureau of the Water Purveyor; and with Horace Loomis, M. Am. Soc. C. E., as Principal Assistant in charge of establishing lines and grades, and the construction of pavements.

In 1889, under a special repaving law, he had charge of all repaving work in New York City below 14th Street, including stone block, asphalt, brick, Telford, and wooden pavements.

In the early part of 1893 Mr. Morrison was appointed by the Supervisors as Engineer of County Roads for the County of Richmond, and, as such, under what was known as the County Road Law, had charge of the preparation of surveys, plans, and specifications for the construction of about 100 miles of modern macadam and block pavements. Of these, 55 miles were completed under his supervision, and, in addition, he designed and superintended the construction of five masonry, brick, and steel highway bridges, two steel swing-bridges, and a wooden trestle roadway, 1 800 ft. long.

He also had charge of the building of 30 miles of trolley railroads, heavy retaining walls, sewers, dock improvements, and a water supply system for the county buildings. In addition, as County Engineer, he had charge of the maintenance of all county roads.

Mr. Morrison served in this position with distinction until consolidation with the City of New York, on January 1st, 1898, when he automatically became connected with the new City government. He was appointed, by Mayor Van Wyck, Deputy Commissioner of the Departments of Highways, Sewers, and Water Supply, and Chief Engineer of the two first-named Departments. This combining of five positions under one official was done for reasons of economy, as it was deemed extravagant at that time to have three fully developed departments in the Borough of Richmond. For four years, or until the beginning of 1902, he had charge of all improvements and maintenance work in the Borough of Richmond. On January 1st, 1902, the revised Charter of the City went into effect, giving each Borough autonomy under its Borough President, and abolishing the former departments. After reorganizing the old departments into bureaus, and placing the construction work, maintenance, and Bureau of Street Cleaning on a good working basis, which he did at the request of Borough President George Cromwell, he separated from the City service and entered into private practice, with offices in the Park Row Building, New York City.

For the next 13 years Mr. Morrison prosecuted a general engineering practice, and in 1913 and 1914 he was specially engaged by the Governor of New York to investigate the frauds in the building of State roads. He was also appointed City School Commissioner in 1912, and served for two years. In September, 1915, he was appointed Commissioner of Public Works for the Borough of Richmond by President Calvin D. Van Name, in which position he served until his death.

Mr. Morrison's skill and experience as a road engineer will be greatly missed in New York City. His ability as a public speaker and his great interest in all educational matters made it impossible to have a successful meeting, public dinner, or entertainment, in the Borough of Richmond, without his active presence.

His friends remember him as a man of most pleasing personality, a ready wit, most entertaining on all occasions, an astute politician, and one whose advice was much sought. His associates in the Department of Public Works miss his sound and practical judgment and advice on important matters.

On April 30th, 1890, he was married to Miss Belle A. Von Eiff, of Brooklyn, N. Y., who survives him.

Mr. Morrison was elected a member of the American Society of Civil Engineers on April 6th, 1898.

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## HENRY MORTON STONE, M. Am. Soc. C. E.*

Died December 8th, 1918.

Henry Morton Stone, the eldest son of the late John William and Hannah Ann (Cowpland) Stone, of Glen Loch, Pa., was born in West Nantmeal Township, Chester County, Pa., on April 28th, 1858.

He was educated at Treemount Seminary, Norristown, Pa., where he studied engineering under the late Dr. John W. Loch. His earliest engineering experience was with railroads in the East, but the greater portion of his life was spent in the service of western roads, or in the employ of Chicago interests.

Mr. Stone's first work was with the Pennsylvania Railroad, Eastern Lines, where he was engaged in the location and construction of the road from Whitings to Bay Head Junction, N. J., and of the "Cut Off" at Lancaster, Pa.

He resigned from the Pennsylvania Railroad to accept a position with the Denver and Rio Grande Railroad, having had charge of the construction of a section of that road in the Rocky Mountains near Dillon, Colo. With the temporary abandonment of this work, he accepted a position with the St. Louis, Iron Mountain and Southern Railroad, and, later, returning to his native State, was employed by a corporation known as the Delaware River, Phoenixville, and Lancaster

* Memoir prepared by J. W. Stone, Esq.

Railroad to locate a railroad through the northern part of Lancaster and Chester Counties. He resigned to accept a position with the Lehigh Valley Railroad Company at Sayre, Pa. While with the Lehigh Valley, he was engaged in making surveys for the entrance of that railroad into Buffalo.

In 1883, Mr. Stone again went West, and accepted a position with the Chicago and Northwestern Railroad, with which he remained for more than five years, his principal work being the construction of new lines in the Northern Peninsula of Michigan.

After leaving the Northwestern, he was for a time Engineer of the Cairo Land and Construction Company, and in that capacity had charge of the construction and maintenance of the dikes at Cairo, Ill. Mr. Stone resigned this position to enter the service of the Chicago, Milwaukee and St. Paul Railroad, where he had charge of double-tracking a considerable section of that road near Marion, Iowa. His next position was with the municipality of Wilmette, Ill.

In 1896, Mr. Stone was sent by a Chicago syndicate of capitalists to Cape Breton, Nova Scotia, to locate and build a railroad (with docks and terminal facilities) from the Western Coast to the coal fields. In 1900, he became Location Engineer for the Algoma Central Railway, in which capacity he located a considerable portion of the present line of that road. Later, he was appointed Bridge Engineer of the same corporation.

On January 1st, 1903, he entered the service of the Chicago, Rock Island and Pacific Railroad, with which corporation he remained until his death, at different times holding the positions of Assistant Engineer at Lincoln, Nebr., Division Engineer at Fairbury, Nebr., and Little Rock, Ark., Location Engineer in charge of location and construction in Texas and Louisiana, District Engineer of the Northern District at Cedar Rapids, Iowa, and of the Southwestern District at Topeka, Kans., and Chief Engineer of the Chicago, Rock Island and Gulf at Fort Worth, Tex. With the abolishment of that position he was for a time with the Valuation Department, and, at the time of his death, was Engineer of Construction in charge of extensive double-track work authorized by the Federal Administration, at Trenton, Mo.

Prior to going to Trenton, Mo., Mr. Stone had been loaned by the Rock Island Railroad Company to the Union Pacific Railroad to take charge of the field work of the reconstruction of the Grand Island Bridge crossing the Missouri River at St. Joseph, Mo.

He was married in Chicago, on September 11th, 1889, to Miss Henrietta Reigart, daughter of Adam W. and Mary Bender Reigart, formerly of Lancaster County, Pa.

He is survived by his widow, residing at Kansas City, Mo., and one son, Morton Reigart Stone, Superintendent of the Idaho Fruit Products Company at Meridian, Idaho.

Mr. Stone was elected a Member of the American Society of Civil Engineers on April 3d, 1907.

## OGDEN MERRILL, Assoc. M. Am. Soc. C. E.*

Died October 5th, 1918.

Ogden Merrill was born in the old Williamsburg section of Brooklyn, N. Y., on December 9th, 1877. His father was one of the founders of Merrill Brothers, which firm was originally located at Grand Street, New York City, as a ship chandlery, in the old days when sailing vessels were still common along the wharves on the East Side. This firm is still in existence, but is now engaged in the manufacture of drop forgings. Mr. Merrill's father is still alive, hale and hearty at 89 years.

Mr. Merrill received his education at the Boys High School, Brooklyn, and at Cornell University, from which he was graduated in the course of Civil Engineering, in 1899.

After graduation, Mr. Merrill entered the employ of the late Ira A. Shaler, M. Am. Soc. C. E., acting as an Assistant Engineer and Superintendent on the construction of the rock tunnel under Park Avenue, New York City, for the Rapid Transit Commission, during the construction of which Mr. Shaler lost his life. Mr. Shaler was noted for his policy of surrounding himself with young engineers, who received their early training under his supervision. Many of those who were graduated from this practical school are now engaged in the construction business for themselves.

After the completion of the foregoing work, Mr. Merrill was employed by the United Engineering and Contracting Company as Engineer and Superintendent, in charge of the construction of the electric pumping station for the dry docks of the New York Navy Yard, the placing of the deck on the elevated structure of the Atlantic Avenue Improvement, Brooklyn, and the bridge over Croton Lake for the Putnam Division of the New York Central and Hudson River Railroad.

Later, Mr. Merrill was Superintendent on the construction of the North River Tunnels of the Pennsylvania Railroad, in New York City, and completed the East River Tunnels of the New York Subway system under Mr. T. J. Brown.

In 1908, Mr. Merrill associated himself with Mr. Albert Ruckgaber in the formation of the Merrill-Ruckgaber Company, Constructing Engineers. Under Mr. Merrill's supervision, as President, this Company has been engaged on numerous projects, confining itself principally to heavy masonry construction and pneumatic work, among the more important of which are the following: Depressed boiler house for the Westchester County Court House at White Plains, N. Y.; pneumatic foundations for the Assay Office, New York City; concrete bridges for the Delaware, Lackawanna and Western Railroad, the Long Island Railroad, and the Central Railroad of New Jersey;

* Memoir prepared by Albert Ruckgaber, Esq.

concrete coal pockets for the Central Railroad of New Jersey; water supply system for the City of Cumberland, Md., including a large concrete dam and pipe line; and pneumatic pier foundations for bridges at Chattanooga, Tenn., and Lawrence, Mass.

Mr. Merrill was the inventor of a method of sinking piers and caissons by the use of a system of nested shaft liners, adapted to be expanded telescopically downward by jacking, as the excavation proceeds. This method he patented and used successfully in sinking caissons for the foundations of the Assay Office Building.

Mr. Merrill left for his summer place at Mountainville, N. Y., on September 27th, 1918, in good health. He apparently carried with him the germs of influenza, which, soon after his arrival at Mountainville, developed into a very virulent form, finally resulting in pneumonia. He died on October 5th, after an illness of only six days.

He was married in 1903 to Miss Laura Ruckgaber, of Brooklyn, N. Y., who, with two children, survives him.

He was noted, among those who knew him best, for his novel and ingenious methods of construction, based on sound engineering principles and carried out by him with marked success. He had a very practical strain, and was an authority on all questions relating to sub-surface and sub-aqueous construction. His upright character and lovable disposition, together with his policy of dealing fairly with men in all walks of life, endeared him, not only to a host of friends, but to those who served under him.

Mr. Merrill was elected an Associate Member of the American Society of Civil Engineers on February 3d, 1904.

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## WARD HALL REAM, Assoc. M. Am. Soc. C. E.*

DIED OCTOBER 4TH, 1918.

Ward Hall Ream, son of Mr. and Mrs. J. J. Ream, was born in Oshkosh, Wis., on October 15th, 1886. He attended the public schools of that city, and was graduated from its High School in 1905. In the fall of that year he entered the Webb Academy of Marine Engineering and Naval Architecture, in New York City, from which he was graduated in June, 1908, and then took a post-graduate course at Columbia University in advanced bridge designing and reinforced concrete.

His first work was with the American Bridge Company. He then served as Bridge Draftsman with the Public Service Commission. In 1910 he entered the employ of the Delaware, Lackawanna and Western Railroad Company as Designer and Estimator of Bridges and Stations. His work included the design of railroad and highway bridges, trestles, towers, and various other forms of construction. It was during this

* Memoir prepared by Edward W. Wendell, Assoc. M. Am. Soc. C. E.

period that the railroad did such a large quantity of improvement work, and, with the study of its problems in steel construction, Mr. Ream was intimately connected.

In 1915, Mr. Ream joined Company C of the 22d Regiment of Engineers, under the command of Col. Vanderbilt, and, in the summer of 1916, went with his Company to the Mexican border. On his return he proceeded with his work on the Delaware, Lackawanna and Western Railroad improvements, until the United States entered the world war. He then entered the Officers' Training School at Camp Myers, Va., and was awarded a Captain's commission. On account of his age, he would not be allowed to take command in active service, and he thereupon asked for a rerating to First Lieutenant. This was granted, and he was assigned to Company C, 305th Engineers. He went overseas in May, 1918.

On October 2d he took charge of his company, relieving Capt. Matthew J. Hoff, and his recommendation for promotion to a captaincy was forwarded to headquarters. In the early morning of October 4th, his company was ordered forward to assist the infantry in an attack. Lieut. Ream had his company in place, and was just finishing his round of inspection to see that everything was all right, when a high explosive shell struck near him. A fragment hit him in the back of the neck, killing him instantly. He was buried, with military honors, in a little concrete vault which was constructed near the spot where he fell.

His admirable qualities made him popular, not only with his intimate friends, but with all those with whom he came in contact in a business and military way. He was terse, modest, persevering, and courageous, and possessed that other indefinable attribute which carries with its possessor the ability to see through the veneer of pretence into the heart of the real. He was a most lovable and loyal friend, and his friends mourn his departure, but rejoice in the fact that when his Maker called, he went with the highest honor that a soldier can attain: "Killed in Action."

Besides his parents, he is survived by a sister, Miss Vinnie Ream, of Oshkosh, and one brother, Edward L. Ream, of St. Paul, Minn.

Mr. Ream was elected an Associate Member of the American Society of Civil Engineers on April 18th, 1916.

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## Special Committees

TO CODIFY PRESENT PRACTICE ON THE BEARING VALUE OF SOILS FOR FOUNDATIONS, ETC.: Robert A. Cummings, Edwin Duryea, E. G. Haines, Allen Hazen, James C. Meem, Walter J. Douglas.

ON THE REGULATION OF WATER RIGHTS: F. H. Newell, W. C. Hoad, John H. Lewis.

TO REPORT ON STRESSES IN RAILROAD TRACK: A. N. Talbot, A. S. Baldwin, G. H. Bremner, John Brunner, W. J. Burton, Charles S. Churchill, W. C. Cushing, Robert W. Hunt, George W. Kittredge, Paul M. LaBach, C. G. E. Larsson, G. J. Ray, Albert F. Reichmann, H. R. Safford, F. E. Turneaure, J. E. Willoughby.

The Reading Room of the Society is open from 9 A. M. to 10 P. M. every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day; during July and August, it is closed at 6 P. M.

HEADQUARTERS OF THE SOCIETY—33 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE NUMBER.....4600 Vanderbilt.
CABLE ADDRESS.....“Ceas, New York.”

BROOKLINE

Vol. XLV. MARCH, 1919. No. 3.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852.

# PROCEEDINGS

This Society is not responsible for any statement made or opinion expressed in its publications.

## SOCIETY AFFAIRS

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## MINUTES OF MEETINGS OF THE SOCIETY

**February 19th, 1919.**—The meeting was called to order at 8:30 P. M.; President Curtis in the chair; T. J. McMinn, M. Am. Soc. C. E., acting as Secretary; and present, also, 325 members and guests.

Nathan C. Johnson, Assoc. M. Am. Soc. C. E., addressed the meeting on the subject, "New Developments in Concrete", illustrating his remarks with lantern slides and moving pictures.

The subject was discussed informally by many of those present.

The following deaths were announced:

Rufus Cameron Hunt, of Washington Court House, Ohio, elected Member, October 5th, 1904; died February 18th, 1919.

Hiram Joseph Slifer, Lt.-Col., Engrs., U. S. A., of Chicago, Ill., elected Member, June 5th, 1907; died in service (France), February 3d, 1919.

ALEXANDER CHARLES SCHILLING, of Severn, N. C., elected Associate Member, June 18th, 1918; died February 4th, 1919.

Adjourned.

**March 5th, 1919.**—The meeting was called to order at 8.30 P. M.; Charles Macdonald, Past-President, Am. Soc. C. E., in the chair; T. J. McMinn, M. Am. Soc. C. E., acting as Secretary; and present, also, 208 members and guests.

The minutes of the Annual Meeting, January 15th, 1919, and of the meeting of February 5th, 1919, were approved as printed in *Proceedings* for February, 1919.

C. E. Fowler, M. Am. Soc. C. E., suggested the appointment of a temporary committee, to confer with the American Railway Engineering Association, at its Chicago meeting on March 17th, 1919, as to the adoption of a new column formula, and also in reference to train loadings. On motion, duly seconded, the whole matter was referred to the Board of Direction.

Mr. Vladimir V. Goriachkovsky, formerly Chief Engineer and Builder of the Murman Railroad, addressed the meeting on "Engineering Construction in Russia, and General Conditions in that Country from the Viewpoint of an Engineer," illustrating his remarks with lantern slides.

The subject was discussed by Messrs. J. E. Greiner, T. Kennard Thomson, and N. Nicolai.

The following deaths were announced:

HOLLAND WILLIAMS BAKER, of Columbus, Ohio; elected Member, May 7th, 1890; died February 18th, 1919.

WILLIAM THOMAS DOUGAN, of New York City; elected Member, October 2d, 1907; died February 3d, 1919.

FRANK CHURCHILL HORN, of Boise, Idaho; elected Member, September 1st, 1903; died February 16th, 1919.

ROBERT EDGAR MILLIGAN, of Newark, N. J.; elected Member, March 4th, 1914; died February 25th, 1919.

JOHN CHRISTIAN OSTRUP, Maj., Engrs., U. S. A., of New York City; elected Associate Member, March 4th, 1896, Member, March 1st, 1899; died in Service, February 27th, 1918.

CHARLES H. KNOWLES, of Los Angeles, Cal.; elected Associate Member, September 2d, 1914; died February 20th, 1919.

JAY WILLIAM TOMS, of Denver, Colo.; elected Junior, November 30th, 1909; died December 20th, 1918.

Adjourned.

## OF THE BOARD OF DIRECTION

(Abstract)

**March 11th, 1919.**—The Board met at 10.54 P. M, immediately after the adjournment of the Membership Committee; President Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Crocker, Elwell, Flinn, A. M. Hunt, Langthorn, Lewis, Metcalf, Rights, Tuttle, and Wagner.

Ballots for membership were canvassed resulting in the election of 16 Members, 46 Associate Members, 1 Associate, and 7 Juniors, and the transfer of 11 Juniors to the grade of Associate Member.

Thirteen Associate Members were transferred to the grade of Member. A report from the Membership Committee was received and acted upon.

Adjourned.

# THE AMERICAN SOLDIER

Address by Brig.-Gen. S. T. Ansell, U. S. A.,
at the Sixty-sixth Annual Meeting of the
American Society of Civil Engineers,
January 16th, 1919.

I was at first much pleased by your invitation, but, alas, it was a case, as is so often true, where grief quickly treads upon the heels of pleasure. When, for the benefit of the programme, if for no greater interest, the authoritative inquiry came for the title of the subject upon which I proposed to address you, pleasure then ceased and gave way to infinite pain and embarrassment. Such is my mortification, even in this hour. Even when Mr. Gardiner, an old-time West Point associate of mine, so courteously asked of me my plan for the evening, evidently suggesting an amiable desire to entertain me, in my confusion and embarrassment, I was still unable to make any response. In a word, I have no subject—no plan. I find myself like a rudderless ship in an uncharted ocean, without compass or destination. Still, must I land somewhere, on something, or, indeed, be landed upon. Were I true to the characteristics of the Englishman—as some one has described his natural reticence—having nothing to say, I should say nothing. Such a philosophical resolution must, however, be seasonably formed. At this late day I am estopped from such a happy choice. Something must be said here and now. Would that I could have prayed to some Pagan power (as was the custom of old) that some thought might strike me.

The programme of the Society for these meetings has, naturally enough, a distinctly military flavor. I observe that several of your speakers are officers of the Army, selected, doubtless, out of an appropriate regard, not only for the present prevalent interest in the Army, but also for the reason that the operations of the Army and military maintenance peculiarly involve matters and problems of the Engineering Profession, as is evidenced by the fact that many great soldiers have been great engineers and many great engineers have been great soldiers. That there is a kinship between the two professions—speaking of them as professions in a technical sense—cannot be denied. It is universally attested by all history. This fact brings no consolation to me, however, inasmuch as it has been amply demonstrated in every educational institution attended by me that a clam will become capable of cutting a caper long before my mental makeup can endow me with engineering appreciations. It may well be, however, that the introduction of a foreign element here may result, not in the usual physical phenomenon in such cases—the generation of friction—but may serve to

divert in a slight, if not helpful, degree, the mind of this meeting from the serious subjects of the profession.

In my judgment, the curse, in a sense, of every profession is its professionalism. There is in almost every profession a particularism that disrespects the environing relation; a universal tendency to segregate from society at large, rather than integrate with it and serve it; a tendency to ignore the civic reasons for its existence; a professional habit to regard the profession as an end in itself, rather than as a means toward social well being. This is particularly true of the two professions to which, in a hermaphroditic and imperfect sense, I myself may be said to belong—the military and the law. Doubtless it can be said with less truth of yours, a utilitarian profession, than any other, if indeed it can be said of it at all.

All professions and all organized human activities are organically inter-dependent. Not only must each contribute its share to the common good, all must be mutually helpful; they must co-operate. This necessitates a mutual interest and something of a common understanding. It has always seemed to me that this lack of common understanding, mutual appreciations and sympathies, has had a considerable retarding influence, not only upon social and political development, but upon professional development itself. Getting somewhat more concrete: The Army itself has suffered, and, for the same reason, the nation doubtless has suffered, because professional men and the people have had so little, or such an incorrect, understanding of the Army as it heretofore existed, and because the Army has had an equally imperfect comprehension of the people and their predispositions and prejudices, and the great current and forces of their purposes.

Professions, in their relations to war or any other great national effort, can no longer stand apart. War is no longer fought by a few trained gladiators, a few selected men to represent an entire nation in a struggle with other nations. The war that is about to be brought to a close and the wars that are to come hereafter (if, unfortunately, such shall come) will be fought by entire nations. National energy will be mobilized and catapulted at the opposing nation. Nations, in a very real sense, will become armed camps. The art and science of war, as war is practiced now and as it will be practiced hereafter, will have to be redefined. Heretofore such a definition had reference to the narrow subject of the Army. Now, it would have to include everything behind the line. If the art and science of war are to be regarded as a thing apart, it is a science of a double aspect, as it were. First, the science of organizing and using national energy for the purpose of redressing a national wrong by every legitimate means, principally force. Secondly, the organization and use of the Army as the principal instrument whereby the force is dealt. One experiences considerable difficulty now in distinguishing between the citizen in the Army and the citizen at

work for the Army. National appreciations are becoming sufficiently broad to include both as soldiers. There is less of a tendency to make invidious distinctions between essentials. Time was when the soldier at the front was the only hero, but we now clearly see that there are heroes behind the line. If the profession of arms is to be regarded as a profession at all, it should be regarded as that profession that calls upon all other professions, vocations, and activities, and converts them to the uses of war.

I suppose I am expected to speak upon something concerning the Army, in the narrow sense, and yet, notwithstanding that the Army is not an unknown subject to me, I find it difficult to speak upon it, and I am quite sure that I cannot do so entertainingly. To adopt the expressive language of the street, I am "fed up" upon it and I believe that you also are. You have heard so much about our army and its wonderful deeds; you are familiar with the novel methods whereby it was raised; you have heard how wonderfully and how quickly it was organized; you have heard, and as engineers can peculiarly appreciate, the Herculean task involved in transporting and maintaining it in fighting efficiency overseas; you have heard with thrills of patriotic pride how bravely it fought to a speedy and victorious conclusion; you know all about the problems of material, personnel, transportation, and the general mechanics involved in raising and maintaining an Army; you surely must have been sickened with the horrors and tragedies of war.

Of course, I have heard all these things; and, rather more intimately than you, I know these things. I had the good fortune to be engaged in observing our Army in France for a space of something like three months. I should be incapable of registering impressions, if I had not registered many. My brief period of service there had a wonderful effect upon me. As a result of it, I believe that I am a better man, a better American, a better officer. Having seen the hills and dales of France made sacred by the blood of many heroes, and her wide-spread ruins wrought by this atrocious strife, I can the better appreciate and give some application to the statement once made by Johnson: "That man is little to be envied whose patriotism would not gain force upon the plains of Marathon, or whose piety would not grow warmer among the ruins of Iona."

I shall not speak of these material things, though it would be far easier to do so. I should like to speak of the things which are less frequently the subject of popular speech, and, perhaps, of popular reflection, but which to my mind count for far more in national military effort than the material side of the military establishment to which I have referred. I should like to invite your attention to what might crudely be called the peculiar intellectuality or personal spirit of this Army, the understanding of which may be of real practical military worth.

As I see it—and I hope it may not appear inappropriate for me to say it here—in our appreciations of the Army we pay too much respect to material elements and too little to the intellectual qualities and spirit that enter into the composition of this Army, and which, in my judgment, dominate it. We over-estimate the realistic elements and under-estimate those impalpable and subtle qualities of the soldiery which, in the mass, made the spirit and morale of the Army, gave it its peculiar National flavor, and enabled it, in my judgment, to attain efficiency and remarkable success under discouraging disadvantages and trying circumstances. I think it is not amiss to invite your attention for a moment to this side of the Army, and thus, in a sense, preserve the balance; for we have seen much of the outside and too little of the inside; we have observed the action of the Army rather than reflected upon its determination; we have been impressed with its power rather than by its moving impulse. In a word, we have taken of it an objective rather a subjective view.

Such a view reveals, at most, but half. Notwithstanding that war seems to be a field in which, when superficially viewed, physical force seems to dominate, other and finer elements do in reality control, more so to-day and in the future than ever before. Formerly, war was in a sense but personal conflict on a large scale; to-day, and hereafter, war is and will be a striving between organized ideals. Although, with a single exception, our wars have always been motived in our political ideals, the present war necessitated the arming of such a vast number of our citizens that the Army has embodied within itself the characteristic qualities of our citizenship which lie at the base of military morale. These qualities of the citizens, carried with them into camp, are calculated to impress themselves upon, and to some extent to modify, the established regimen of the military establishment.

I have already adverted to the kinship between your profession and that of Arms. They both have been thought heretofore to deal largely with physical forces in fields in which the less palpable and subtler forces, which move men in other environments, have had little place. The education and training of the engineer and the military officer alike have had prime regard for this fact. Hereafter, I apprehend there will be less kinship between us. The adjunctive and technical services of the Army will doubtless continue to require the old mechanical training. They still will deal largely with things and will drive the human agencies as bits of mechanism to perform them. Not so with the fighting forces. Military leadership, hereafter, must regard men of Arms, not as machines, but as human beings, with human capacities, impulses, and ideals; must have a larger appreciation of the qualities of citizenship, which project themselves over and into the military status, which were not doffed as the uniform was donned. In a large sense, all the great captains have had this quality, though it

was not a requirement or objective of orthodox military training. The commander is a commander of men, not machines. He must have those qualities which will enable him to appreciate and utilize the qualities and ideals of his men. Only thereby can he inspire them to reach the great heights which American citizens are capable of reaching when properly understood and properly led, heights at which they become as indomitable as the spirit which animates them.

In speaking of the Army, I, of course, speak of the new Army. The new Army belongs to the new era in warfare, wherein whole nations fight. It differs vastly, therefore, from any army this country has heretofore raised. If the people did not understand our old-time Army, it was for one reason—because it was too small to elicit their interest. If they do not understand this Army, it is rather because it was too large at birth, and our faculties have not kept pace with its growth. If the people did not understand the old Army, it was because it did not come from the people. If they do not understand the new Army, it is largely because it came from the people too abruptly.

The new Army, in its organic character, has a peculiar relationship to the old Army. If the old Army had never done anything else in all the world, it would deserve the lasting thanks and praise of the American people for the creation and direction of the new establishment. The old Army organized the new, gave it its standards and its traditions, so far as they could be given, gave it birth, as it were, and in doing so, itself died. The new Army, though theoretically the successor of the old, is a very different institution. It may have the text of the same laws for its government, but those laws will have to undergo many modifications in practice when applied to the new establishment. Such an army develops a new leadership and a new standard for discovering and estimating military qualifications. In the old Army's strength was its system. It was well trained and well organized. Its organizational system took the burden, and absorbed personal and particular deficiencies. The standard product of the system was the thing aimed at and obtained. Human quality was not its prime regard.

In such an army as the new Army, however, the laws will have to be applied with due allowance for the inherent differences. Systems of instruction will have to be modified to give the best results. The unimparted reason back of the schoolmaster's method will not satisfy such an establishment. In such an army, reasoning methods, sympathetic methods, will give better, quicker, and more satisfactory results. Instruction cannot be handed out empirically to non-commissioned officers and men, leaving them to discover the reasons later in the course of a long service and full experience.

In such an army, there must be new tests and new determinations. In the old Army, the officers were especially trained to command. They were set aside for the purpose. The law gave them their training and

conclusively established their competency. The law jealously regarded their rights which, on the score of personal qualification, there was none to dispute. So it was, in a lesser sense, with the old non-commissioned officer. His place was also fixed by law. He came to it by reason of long and faithful service, and a consequent superior fitness; but, in the new establishment, mere conclusions of law and presumptions of fitness will be of less weight. Though aided by the authority of law, nevertheless every man exercising command will have to take his real place as a commander of men. In the long run, he will have to demonstrate his worth.

Such an army must be dealt with by those who have large sympathies and large appreciations. I think the mechanical education will hereafter take a less important place in the curriculum of military training, and will be superseded to some extent by a greater knowledge of the liberal arts, sciences, and humanities. It is doubtful if the education, and training, and experience of the engineer will hereafter be regarded so highly in the military profession. A study and knowledge of human beings, rather than machines, will be a necessary part of the professional training of officers of the army. The old-time regular, to a large extent, had in his hand the making of the new Army, the new officer, and none can deny that the task was well accomplished; but we Regulars, ourselves, have also learned and broadened. From the new man we have got new views and new appreciations. Doubtless the new man needed some of what the old man needs or can acquire from his new-made brother. We must understand, however, that we are in a different environment, with new men to handle, new methods to be applied. We must understand them and ourselves, their training and ours. Our education suited us exactly to the old establishment. However, it will need modifications to meet the military requirements of the future. For present purposes, it consists too much of the technical and purely utilitarian. Our course at West Point carried little or nothing of the humanities, little or nothing that quickens the sympathies and arouses the imagination. Indeed, it excluded those qualities. Sympathy and imagination, these are the two qualities we must possess, to be at our best in the new establishment. Without sympathy and an appreciation of the human qualities we shall be at some disadvantage in dealing with human beings who are not and never will be machine made. The new officer is largely a college man, with an individualism over-developed. College insists upon such development. College has nothing or little of immediate practical value in its curriculum. It aims to cultivate the esthetic side, the sympathies, the imagination—all this in order that human beings may be interested and influenced. Much of this is of great military worth, and, whether of military worth or not, it is there to be dealt with. Some of it may be modified out of military existence, and some of it will last and remain

a permanent and strengthening element in the new establishment. We must widen the scope of our sensibilities until it shall include an appreciation of the common humanities. What a rare opportunity we regulars have had, an opportunity to serve our God and our country; to establish ourselves in the affections of this great popular Army, and, through it, in the everlasting esteem of our people.

We must have this breadth of appreciation if we are to understand our present military establishment. The spirit of this new Army was the spirit which caused it to win. It was a spirit pervaded by an unprecedented sense of equality. It was a spirit upon which rank, power, and earthly circumstance did not as such impress themselves. It was the spirit of personal democracy; a student of the classics and a mule driver became chums, and each gained much from the other. The society man, the club man, the college man, the farm lad, and the man who had been engaged in menial labor all touched elbows in their daily associations, and in each was bred a spirit of generosity and respect for the other which served as the keystone of the strength of this remarkable human structure. They were all inspired with the great pride of nation and race. They realized that this was the first time that an American Army had ever been exhibited to the world. They insisted that it should lose nothing in the exhibition.

The Army, upon its demobilization, will be the means of disseminating such a spirit throughout the land. All classes fought for a common cause, a cause that was higher than that of any class. Will men who have once been dominated by such a spirit lay it down upon the resumption of their civil status? If so, the nation will have been the great loser. If so, it would seem that the spirit of patriotism exists for but an occasion—and that occasion is war—and does not pervade our civil activities and vocations which, if they but be pursued in the spirit that characterized this Army, must bring happiness, prosperity, liberty, and all the blessings of government.

# ITEMS OF INTEREST

## United Engineering Society

### Extracts from Treasurer's Annual Report

### For Year Ending December 31st, 1918.

The Surplus Account, on December 31st, 1917, showed a balance of $8 116.10. This amount has been increased by the surplus from the operating accounts during the year, of $5 417.33, making a total on December 31st, 1918, of $13 533.43. Of this amount, $8 000.00 has been transferred to Depreciation and Renewal Fund, leaving a balance in Surplus Account of $5 533.43.

The Gross Operating Expenses for the year 1918 were $66 505.57.

The General Operating Expenses during the year 1917 were $53 791.97, showing an increase for the year 1918 of $12 713.60, partly due to the three additional stories first occupied in October, 1917.

The funds available for the Library Board, and spent under its direction during the year, amounted to $28 740.29.

The General Reserve Fund of $10 000, created by the Board of Trustees at a meeting held November 18th, 1914, to be available to take care of unforeseen fluctuations of income and outlay, has been preserved intact, there arising no calls on this fund during the year 1918.

The Depreciation and Renewal Fund at the beginning of the year 1918 amounted to $75 037.41. During the year this fund has been increased by the sum of $3 126.37 for interest earned by the investments for this fund during the year and accruals, and by $8 000.00 added from the surplus at the end of the year, making a total of $86 163.78 on December 31st, 1918.

In accordance with the authorization of the Board of Trustees, September 26th, 1918, the sum of $10 000 was invested in Fourth Liberty Loan 4¼% Gold Bonds.

The following summary shows the amounts of the funds held by the United Engineering Society as of December 31st, 1918:

| | |
|---|---|
| Depreciation and Renewal Fund, December 31st, 1917.. | $75 037.41 |
| Interest on invested funds during the year 1918..... | 3 126.37 |
| Transfer for the year 1918..... | 8 000.00 |
| Total ..... | $86 163.78 |
| General Reserve Fund..... | 10 000.00 |
| Engineering Foundation Fund..... | 303 374.80 |
| Library Endowment Fund..... | 102 559.70 |

ASSETS AND LIABILITIES

December 31st, 1918.

ASSETS

| | |
|---|---|
| Real estate | $1 947 171.16 |
| Investments, Engineering Foundation Fund | 303 321.25 |
| Investments, Library Endowment Fund | 102 297.50 |
| Investments, General Fund | 85 725.00 |
| Cash | 12 869.60 |
| Petty cash | 100.00 |
| Unexpired insurance | 5 958.76 |
| Accrued interest receivable | 2 392.02 |
| Accounts receivable, general | 542.58 |
| Bills receivable | 12 500.00 |
| | $2 472 877.87 |

LIABILITIES

| | |
|---|---|
| Founders equity in property | $1 947 171.16 |
| Due the General Reserve Fund | 10 000.00 |
| Due the Depreciation and Renewal Fund | 86 163.78 |
| Due the Library Endowment Fund | 102 559.70 |
| Due the Engineering Foundation Fund | 303 374.80 |
| Due for notes payable, A. S. M. E. | 12 500.00 |
| Due for accounts payable | 2 090.24 |
| Due for Library 1918 unexpended balance | 274.26 |
| Due for Library Service Bureau 1918 surplus | 800.29 |
| Due for Engineering Council 1918 unexpended balance | 2 410.21 |
| Surplus (December 31st, 1918) | 5 533.43 |
| | $2 472 877.87 |

**Report of Members on Naval Consulting Board.**

"NEW YORK, FEB. 27, 1919.

"MR. CHARLES WARREN HUNT, *Secretary,*
American Society of Civil Engineers,
33 West 39th Street, New York, N. Y.

"DEAR SIR: As the official nominees and representatives of the American Society of Civil Engineers on the Naval Consulting Board of the United States, the undersigned beg to submit the following report of the Board's activities during the year ending December 31, 1918. It will be realized that on account of the confidential nature of the duties performed by the Naval Consulting Board, its members would not be justified in making a full report as to its activities. We are therefore obliged to confine ourselves to the statements made concerning the Board by the Secretary of the Navy in his last Annual Report, which follow.

"Yours truly,

"ALFRED CRAVEN,
*"Member, Naval Consulting Board.*
"A. M. HUNT,
*"Member, Naval Consulting Board."*

### Anti-Submarine Devices.

"The Department has been keenly appreciative of the necessity of employing every effort to develop devices with which to combat the enemy's submarine operations. Advices and suggestions were freely requested and carefully considered by the department, the Naval Consulting Board, the National Research Council, the various bureaus and departments, the General Board of the Navy, and other boards in Washington.

"In order to co-ordinate the efforts in this matter the department appointed a special board of officers to have complete charge of carrying out experiments on anti-submarine devices. The General Electric Co., the Western Electric Co., and the Submarine Signal Co. patriotically offered every assistance in this work, and with a fine spirit of co-operation have rendered valuable service.

"An experimental station was established at New London, Conn., under the supervision of the special board, and many scientists of unusual attainments were assembled there in connection with the experiments and developments of devices for detecting submarines. The naval activities at New London, Conn., embrace also a station for assembling and installing various devices developed and training the personnel for the efficient employment of such devices afloat. The results achieved by these methods have been most gratifying; and the operations of vessels fitted with these devices both abroad and in home waters, has had a marked effect in restricting submarine operations.

### Developing Inventions and Devices.

"The work of the Naval Consulting Board has increased greatly in both importance and volume during the past years. In addition to work especially adapted to naval uses, the members have assisted in almost every field of research, and Mr. Thomas A. Edison, president of the board, is still devoting his entire time and his laboratory to war work.

More than 110 000 ideas, inventions and devices have been considered by this board and the department, either separately or conjointly; there have been 4 200 interviews on inventions and upwards of 700 models have been examined. In addition, at the Chicago branch office 2 300 interviews have been granted and 2 500 communications investigated. This gives an idea of the volume of this work and the care that is taken in considering and investigating every invention or suggestion that gives promise of being of any value.

### Bulletins on Submarine and Aviation.

"A very complete bulletin on the enemy submarine has been prepared, after the most careful study and compilation of all data, and was issued under date of May 1, 1918. This gave all but the most confidential information on the subject and has served as a guide to the country at large in making suggestions. A second bulletin on the subject of aeronautics, composed of articles prepared by a number of the best authorities on the subject, was issued on August 1, 1918. This pamphlet included a carefully prepared bibliography that is complete and exhaustive and gives the student in aviation a most valuable fund of information.

"During the past year the war committee of technical societies, composed of representatives of the great engineering societies, associated themselves with the Naval Consulting Board and their chairman, Mr. David W. Brunton, was elected a member of the board.

"With the erection and occupancy of the New Navy Building, space was provided for the resident member and a staff of examiners directly connected with the office of the Secretary of the Navy, and all the files and correspondence have been concentrated in one location, bringing the examination and consideration of ideas and inventions in closer touch with the Navy Department. The office of the Board is in charge of Mr. Brunton, who is also a member of the advisory committee to the inventions section of the General Staff of the Army, and there is established a close working basis of handling all ideas presented to the attention of the proper authorities with the least effort and by a very direct route. This has not only resulted in increased efficiency, but in a reduction of expenditure of funds and time consumed.

SUBJECTS THAT HAVE BEEN STUDIED.

"Among the subjects studied by the Board were: Aeronautics, propellers for airplanes, stabilizing and controlling devices, and an instruction machine that has been adopted for use; optical glass, improvements in quality and production; ordnance equipment; anti-submarine defensive devices and offensive instruments; internal combustion engines, refined hydrocarbon fuel for airplane engines giving greater efficiency and longer life to machines, and methods of coal combustion looking to higher economy.

"When the department called for classes of electrical and mechanical engineers from which to select a number of commissioned officers for active service, the board was of material assistance in its prompt and efficient handling of the situation, and as a result the Navy was enabled to obtain an excellent selection of able and experienced officers.

"The officers and members of this board give their time and talents, many of them to the exclusion of their private business, from a desire to render a patriotic and disinterested service. They are entitled not only to the thanks of the department, but of the large number of other agencies and individuals that have benefited by their counsel and advice.

"Approved

"JOSEPHUS DANIELS."

### Letters to Governors of States

Under date of January 30th, 1919, the Secretary of the American Society of Civil Engineers sent the following letter to the Governor of each State:

"NEW YORK, JANUARY 30TH, 1919.

"SIR: State and municipal authorities, corporations, and individuals who now have, or expect in the near future to have, need for the services of professional engineers are requested to communicate their wants immediately to the Engineering Societies Employment Bureau, 33 West 39th Street, New York City. This Bureau is maintained by the

four National Societies of Civil, Mining, Mechanical, and Electrical Engineers.

"A number of engineers who have been serving in the Army or in Government capacities during the war are about to be released from their present duties. It is the desire of the Engineering Societies to place these engineers in touch with contemplated projects as early as practicable.

"In the present emergency the lack of openings for civil engineers has been observed, and it is to provide, if possible, for these men that this notice is issued.

"American Society of Civil Engineers,
"Chas. Warren Hunt,
*"Secretary."*

"To the Hon.————
*Governor of*————

A number of replies have been received which indicate that interest in a revival of construction is being taken by the chief executives of the various States.

A similar letter also was sent by the Secretary to the more prominent daily newspapers, many of which published articles based on the information given.

### The John Fritz Medal

The John Fritz Medal was established by the professional associates and friends of the late John Fritz, Hon. M. Am. Soc. C. E., of Bethlehem, Pa., on August 21st, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress. The medal is awarded for notable scientific or industrial achievement. There is no restriction on account of nationality or sex. The medal is of gold and is accompanied by an engraved certificate which recites the origin of the medal and the specific achievement for which the award was made. The medal may be awarded annually, but not oftener. No award shall be made to any one whose eligibility to the distinction has not been under consideration by the Board of Award for at least one year. The award is made by a Board of sixteen appointed in equal numbers from the membership of the four National Societies: American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

The John Fritz Medal has been conferred upon the following distinguished Engineers:

1902—John Fritz, for scientific and industrial achievement.

1905—Lord Kelvin, for work in cable telegraphy and other general scientific achievements.

1906—George Westinghouse, for the invention and development of the air-brake.

1907—Alexander Graham Bell, for the invention and introduction of the telephone.

1908—Thomas Alva Edison, for the invention of the duplex and quadruplex telegraph; the phonograph; the development of a commercially practical incandescent lamp; the development of a complex system of electric lighting, including dynamos, regulating devices, underground system, protective devices and meters.

1909—Charles Talbot Porter, for his work in advancing the knowledge of steam engineering and improvements in engine construction.

1910—Alfred Noble, for notable achievements as a civil engineer.

1911—Sir William Henry White, for notable achievements in naval architecture.

1912—Robert Woolston Hunt, for his contributions to the early development of the Bessemer process.

1914—John Edson Sweet, for his achievements in machine design; and for his pioneer work in applying sound engineering principles to the construction and development of the high-speed steam engine.

1915—James Douglas, for notable achievements in mining, metallurgy, education and industrial welfare.

1916—Elihu Thomson, for achievements in electrical invention, in electrical engineering and industrial development, and in scientific research.

1917—Henry Marion Howe, for his investigations in metallurgy, especially in the metallography of iron and steel.

1918—J. Waldo Smith, for distinguished services in engineering and achievement as an engineer in providing the City of New York with a supply of water.

### Engineers' Registration Act for Oregon

The following copy of the Engineers' Registration Act for Oregon is printed for the information of the membership. The Act has just been passed by the Legislature of that State. The Governor has not yet signed the bill, but, as he has spoken favorably of the measure, there is little doubt that it will receive his signature. The bill was drawn originally by a Committee appointed by the four Founder Societies,* and sponsored by the Northwestern Society of Highway Engineers, the Oregon Society of Engineers, and, in part, by the Portland, Oregon, Association of Members of the American Society of Civil Engineers. It was, in general, favored by the younger members of the Portland, Oregon, Association, and opposed by the older and more conservative members:

"A Bill for an Act to Provide for the Registration of Professional Engineers, Creating a Board of Engineering Examiners and Defining

* The work of this Committee, while never formally adopted by any of the invidivual Societies, has been justified by the practical adoption in this and other States of the tentative bill prepared by it.—*Secretary.*

Their Duties, Fixing the Fees for Registration, Fixing the Penalties for Violations, and Making the Necessary Appropriations.

"Be it Enacted by the People of the State of Oregon:

"Section 1. Definitions.—As used in this Act:

"1. The 'board' means the state board of engineering examiners provided for by this Act.

"2. A person practices professional engineering within the meaning of this Act who practices any branch of the profession of engineering other than military engineering. The practice of said profession embraces the design and the supervision of the construction of public and private utilities such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouse, wet docks, drydocks, ships, barges, dredges, cranes, floating docks and other floating property, the design and the supervision of the construction of steam engines, turbines, internal combustion engines and other mechanical structures, electrical machinery and apparatus, and of works for the development, transmission or application of power, the design and the supervision of mining operations and of processes and apparatus for carrying out such operations, and the design and the supervision of the construction of municipal works, irrigation works, water supply works, sewerage works, drainage works, industrial works, sanitary works, hydraulic works and structural works and other public or private utilities or works which require for their design or the supervision of their construction such experience and technical knowledge as are required in Section 8 of this Act for admission to examination. The enumeration of any public or private utilities or works in this section shall not be construed as excluding any other public or private utilities or works which require such experience and technical knowledge for their design or the supervision of their construction. The execution as a contractor of work designed by a professional engineer or the supervision of the construction of such work as a foreman or superintendent for such a contractor shall not be deemed to be the practice of professional engineering within the meaning of this Act.

"3. 'Professional engineer' means any person who practices professional engineering.

"Section 2. Qualifications.—After January first, nineteen hundred and twenty, no person shall practice professional engineering without having first been duly and regularly registered by the board as a professional engineer as required by this Act nor shall any person practice professional engineering whose authority to practice is revoked by the board; after January first, nineteen hundred and twenty, every map, plan and drawing required by law to be certified or approved by a professional engineer shall be certified or approved by a professional engineer duly and regularly registered by the board as a professional engineer as required by this Act and shall bear the date and the number of the certificate of registration of such professional engineer; and after January first, nineteen hundred and twenty, no diploma or certificate conferred on or granted to a person other than a certificate issued under this Act by the board or its secretary shall be lawful authority for the practice of professional engineering.

"Section 3. The state board of engineering examiners.—There shall be a state board of engineering examiners consisting of nine members

to be appointed by the governor. Of the members of the board first appointed hereunder three shall hold office until July first, nineteen hundred and twenty-one, three shall hold office until July first, nineteen hundred and twenty-three, and three shall hold office until July first, nineteen hundred and twenty-five; and the term of office of each member so appointed shall begin on July first, nineteen hundred and nineteen. Upon the expiration of each of such terms one term of office of each member thereafter appointed shall be six years from July first. The governor may remove any member of the board for misconduct, incapacity or neglect of duty. Vacancies in the board caused by death, resignation or removal from office shall be filled by appointment by the governor for the unexpired term. Each member of the board shall be a professional engineer of at least ten years' active experience and of recognized good standing in his profession, shall be at least thirty-five years of age and shall have been a resident of this state for at least one year immediately preceding his appointment. Each member of said board, except the members first appointed hereunder, shall also be a registered professional engineer. The members of the board shall serve without compensation except traveling and other necessary expenses.

"Section 4. Certificate of appointment; oath; powers.—Every member of the board shall receive a certificate of his appointment from the governor and before beginning his term of office shall file with the secretary of state the constitutional oath of office. Each member of the board first appointed hereunder shall receive a certificate of registration under this Act from said board. The board or any committee thereof shall be entitled to the counsel, advice and services of the attorney general, shall have power to compel the attendance of witnesses, and may take testimony and proofs concerning all matters within its jurisdiction. The board shall have an official seal to be furnished and provided by the secretary of state. The board may make all by-laws and rules not inconsistent with law needed in performing its duties; but no by-law or rule by which more than a majority vote is required for any specified action by the board shall be amended, suspended or repealed by a smaller vote than that required for action thereunder.

"Section 5. Officers; meetings; quorum.—The board shall biennially elect from its members a president and a vice-president for the ensuing biennial term. The board shall appoint a secretary, who shall not be a member of the board, but who shall possess the qualifications required by this Act for members thereof. The secretary shall hold office during the pleasure of the board and shall receive an annual compensation of twelve hundred dollars ($1 200.00). He shall give a bond in such amount and with such sureties as may be approved by the state board conditioned for the faithful performance of his duties and for the accounting for, and payment over of, all moneys received by him. The secretary shall keep on file in the office of the board a record of all certificates of registration issued, and he shall receive and account for all fees derived from the operation of this Act. He shall also perform such other duties as may from time to time be assigned to him by the board.

"The board shall hold at least six stated meetings in each year. Special meetings may be called in such manner as the by-laws of the board may provide. Notice of all meetings shall be given in such a

manner as the by-laws of the board may provide. At any meeting of the board held solely for the examination of candidates for registration three members shall constitute a quorum; but if three or more members shall not attend at the time and place fixed for such meeting, the member or members present may adjourn the meeting from time to time until a quorum be present. At all other meetings a majority of the board shall constitute a quorum.

"Section 6. Additional employes and officers.—The board shall have power to employ, during its pleasure, such clerks and other employees and to rent such offices as may be necessary to the proper performance by it of its duties as in this Act prescribed.

"Section 7. Payment of salaries and expenses; report.—The fees derived from the operation of this Act shall be paid into a special fund in the state treasury, to be known as the Engineer's Registration Fund, which is hereby created. Warrants for the payment of salaries and expenses incurred shall be issued by the Secretary of State and paid by the state treasurer out of the Engineer's Registration Fund, upon presentation of vouchers regularly drawn and approved by the president and the secretary of the board. On or before the first day of February in each year beginning in the year nineteen hundred and twenty-one the board shall submit to the legislature a written report of its proceedings for the preceding year and shall file with the Secretary of State a copy of said report together with a complete statement of the receipts and expenditures of the board for the preceding year, verified by the oath of the secretary, and a complete list of all persons registered to practice professional engineering under this Act with their addresses and the dates of their certificates of registration.

"Section 8. Admissions to examinations.—The board shall admit to examination any candidate who pays a fee of ten dollars ($10.00) and submits evidence verified by oath and satisfactory to the board, that he

"1. Is more than twenty-one years of age,

"2. Is of good character, and

"3. Has been engaged upon engineering work for at least six (6) years and during that period has had charge of engineering work, as principal or assistant, for at least one year.

"4. Or, in lieu of the third requirement specified above, is a graduate from an engineering school of recognized good reputation and has been engaged upon engineering work for at least four years and during that period has had charge of engineering work, as principal or assistant, for at least one year.

"Section 9. Examinations.—Examinations for registration shall be held at stated or special meetings of the board at such times and at such places within this state in each year as the board shall determine. The scope of the examinations and the methods of procedure shall be prescribed by the board. The examinations may be either oral or written or partly oral and partly written. As soon as practicable after the close of each examination the members of the board who shall have conducted such examination shall make and sign and file in the office of the board a certificate stating the action of the board upon the application of each candidate, whereupon the secretary of the board shall notify each candidate of the result of his examination.

"Section 10. Certificates of registration.—Upon receipt of an additional fee of five dollars ($5.00) the board shall issue to any applicant who has been certified as having passed the examination conducted by the board a certificate of registration signed by the president and the secretary of the board under the seal of the board, whereupon such applicant shall be authorized to practice professional engineering as defined by this Act.

"The board shall from time to time examine the requirements for the registration of professional engineers in other states, territories and countries and shall record those in which, in the judgment of the board, standards not lower than those provided by this Act are maintained. The secretary of the board, upon the presentation to him by any person of satisfactory evidence that such person holds a certificate of registration issued to such person by proper authority in any such state, territory or country so recorded and upon receipt by him of a fee of fifteen dollars ($15.00), shall issue to such person a certificate of registration under this Act signed by the secretary under the seal of the board, whereupon the person to whom such certificate is issued shall be entitled to all the rights and privileges conferred by a certificate issued after examination by the board.

"Section 11. Registration without examination.—The board shall at any time on or before January first, nineteen hundred and twenty, issue a certificate of registration signed by the president and the secretary of the board under the seal of the board, upon due application therefor and the payment of a fee of fifteen dollars ($15.00), to any candidate who shall submit evidence, verified by oath and satisfactory to the board, that he is of good character and has practiced professional engineering for at least six years preceding the date of his application and during that period has had charge of engineering work as principal or assistant for at least two years. After January first, nineteen hundred and twenty the board shall issue certificates of registration only as hereinbefore provided.

"Section 12. Registry; revocation and reissue of certificates of registration.—All certificates of registration issued by the board or its secretary shall be in such form as the by-laws of the board may prescribe. Before any certificate of registration is issued by the board or its secretary, it shall be numbered and recorded in a book kept for that purpose in the office of the board and the number of the certificate shall be noted on the certificate. Such record shall be open to public inspection and in all actions or proceedings in any court such record or a transcript of any part thereof certified by the secretary of the board under the seal of the board to be a true copy shall be entitled to admission in evidence.

"The board shall have power at any time to inquire into the identity of any person claiming to be a registered professional engineer and after due service of a notice in writing, require him to prove to the satisfaction of the board, that he is the person authorized to practice professional engineering under the certificate of registration by virtue of which he claims the privilege of this Act. When the board finds that a person claiming to be a professional engineer registered under this Act is not in fact the person to whom the certificate of registration was issued, it shall reduce its findings to writing and file them in its

office. Such findings shall be prima facie evidence that the person mentioned therein is falsely impersonating a professional engineer of a like or different name.

"The board may revoke a certificate of registration of a professional engineer for fraud or deceit in his practice or in the securing of his certificate or for the conviction of crime. Proceedings for the revocation of a certificate of registration shall be begun by filing with the board a written charge or charges against the accused. These charges may be preferred by any person or corporation or the board may on its own motion direct its secretary to prefer such charges. When charges are preferred against a professional engineer registered under the provisions of this Act, the board shall designate not less than three of its number as a committee to hear and determine said charges. A time and place for the hearing shall be fixed by said committee and a copy of the charges together with a notice of the time and place for the hearing shall be served upon the accused or his counsel at least ten days before the date fixed for said hearing. Where personal service or service upon counsel cannot be effected and such fact is certified on oath by any person duly authorized to make legal service, the board shall cause to be published for at least seven times, the first publication to be at least thirty days prior to the hearing, in two newspapers published in the section of the state in which the accused was last known to practice a notice to the effect that at a definite time and place a hearing will be had on the charges against the accused upon an application to revoke his certificate. At said hearing the accused shall have the right to cross-examine witnesses against him and to produce witnesses in his defense and to appear personally or by counsel. The said committee shall make a written report of its findings and recommendations and shall forthwith submit the same to the board. If the board shall find that said professional engineer has been guilty of any fraud or deceit in his practice or has been guilty of any fraud or deceit by which he was admitted to practice or has been convicted of crime, it shall revoke his certificate of registration. A two-thirds vote of all the members of the board shall be necessary for this action. The action of the board shall be recorded in the same manner as certificates of registration are recorded and the name of the person whose certificate of registration is so revoked shall be stricken from the list of registered professional engineers and he shall be disqualified from practicing as professional engineer.

"The board may reissue a certificate of registration to any person whose certificate has been revoked, but only after the expiration of one year from the date of such revocation, for reasons which the board shall by a two-thirds vote of all its members determine to be satisfactory.

"Section 13. Action of the board.—The members of the board or of any committee thereof and the secretary of the board in granting, withholding, revoking or reissuing a certificate of registration shall be deemed to be acting as officers of the state and it shall be the duty of the attorney general to represent and appear for them or any of them in any action or proceeding brought against them or any of them because of any such act.

"Section 14. Certificate presumptive evidence.—Every unrevoked certificate and endorsement of registry made as provided in this Act

shall be presumptive evidence in all courts and places that the person named therein is legally registered.

"Section 15. Penalties.—Any person who not being legally authorized to practice professional engineering within this state according to the provisions of this Act and so registered according to law shall practice, or attempt or advertise to practice, or hold himself out as authorized to practice professional engineering or shall use in connection with his name or otherwise assume, use or advertise any title or designation tending to convey the impression that he is a professional engineer and any person who shall buy, sell or fraudulently obtain any certificate of registration or who shall aid or abet such buying, selling or fraudulently obtaining or who shall practice, or attempt or advertise to practice or hold himself out as authorized to practice professional engineering under cover of any certificate obtained or issued fraudulently or unlawfully or under fraudulent representations or mistake of fact in a material regard and any person who shall practice, or attempt or advertise to practice, or hold himself out as authorized to practice professional engineering under a false or assumed name or who shall falsely impersonate any professional engineer or former professional engineer of a like or different name shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not less than $25.00 or more than $500.00, or imprisonment in the County Jail not to exceed six months.

"Section 16. Application of Act.—This Act shall not apply to any professional engineer working for the United States government; nor to any architect practicing architecture; nor to any professional engineer employed as an assistant to a professional engineer registered under this Act; nor to any professional engineer coming from without this state and possessing the qualifications for the practice of professional engineering as provided for in this Act in any branch of engineering; he shall be permitted to practice not to exceed three months before making application for examination under the terms of this Act; provided that the service of professional engineers in the U. S. military service shall be considered as the practice of professional engineering, and provided further that such army engineers may be registered without examinations, as provided in Section seven hereof, within a period of one year from the date of their discharge.

"Section 17. Time of taking effect.—This Act shall take effect on the first day of July, nineteen hundred and nineteen (1919)."

### Exhibit of Army Personnel Work

Employers and others interested in personnel work will have an opportunity to examine the methods developed by the Committee on Classification of Personnel in the Army at an exhibit to be shown on the Auditorium (third) floor of the Engineering Societies Building, 29 West 39th Street, New York City, April 1st to 12th, 1919. The exhibit consists of a collection of wall charts, forms, photographs, and models showing how the Army finds out what men can do best and how it uses that information; how soldiers are trade-tested, and how officers

are rated and fitted into place; how the work is checked and supervised, and its results in the war.

The collection is being shown under the auspices of the National Association of Corporation Schools. It was on exhibition for several weeks at Washington, where it excited so much interest that, in response to many requests, the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its various features.

### Advisory Engineering Committee for New York State

The following engineers, representing the several branches of the profession, have been selected by Engineering Council to advise and confer with the Reconstruction Commission of the State of New York: George W. Fuller, chairman, Dr. George F. Kunz, H. deB. Parsons, L. E. Stillwell, and Paul G. Brown.

This body will be known as the Advisory Engineering Committee, and is at present interested in the following Public Works: the Vehicular Tunnel, Water Power Developments, Port and Harbor, Garbage, Sewerage, and Highway Construction.

The Reconstruction Commission was recently appointed by Governor Smith, with Abram I. Elkus as Chairman. The office of the Advisory Engineering Committee is located with the Reconstruction Commission at the Hall of Records, New York City.

### The Tunnel Under the Pyrenees Completed

It is reported that the Franco-Spanish Tunnel under the Pyrenees Mountains, between Puigcerda, Eastern Spain, and Ax, France, has been completed. The distance between Puigcerda, and Ax is about 20 miles. The tunnel is the result of more than ten years of negotiation between the Spanish and French Governments, the final arrangements being completed in 1915. It will shorten the distance between Paris and Madrid by about 200 miles.

The railway communications between the two countries are scanty, there being only two roads, and they are at the ends of the Franco-Spanish border. Most of the commerce is carried on by sea.

### Change in Name of the American Institute of Mining Engineers

By a letter-ballot of the members of the American Institute of Mining Engineers, as reported by the tellers and announced by the President at the annual business meeting of the Institute on February 18th, 1919, the name of the Institute has been changed to the American Institute of Mining and Metallurgical Engineers.

### Appointment of New York State Highway Commissioner

Col. Frederick Stuart Greene, M. Am. Soc. C. E., of Sands Point, Long Island, who has just returned from service in France with the Seventy-seventh Division, has been named by Governor Smith as State Highway Commissioner for New York. The term of office is eight years and the salary $8 000 per year. The New York State Highway Department, it is expected, will spend about $23 000 000 during 1919.

## ANNOUNCEMENTS

**The Reading Room of the Society is open from 9 A. M. to 10 P. M., every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day.**

### FUTURE MEETINGS

**April 2d and 16th, 1919.—8.30 P. M.**—Meetings will be held as usual on these evenings, that of April 2d being the regular business meeting of the Society. The arrangements for the second meeting are in the hands of the New York Meetings Committee, and programmes for both meetings will be announced later.

**May 7th, 1919.—8.30 P. M.**—A regular business meeting will be held, and a paper by A. F. Parker, M. Am. Soc. C. E., entitled "The East Canyon Creek Dam", will be presented for discussion.

This paper is printed in this number of *Proceedings*.

### ANNUAL CONVENTION

The Forty-ninth Annual Convention of the Society will be held in the "Twin Cities" of St. Paul and Minneapolis, Minn., from June 17th to 20th, 1919, inclusive.

The arrangements are in the hands of a Committee of the Board of Direction, consisting of Messrs. W. L. Darling, Chairman, E. E. Wall, and Chas. Warren Hunt. A local Committee of sixteen members, of which Mr. R. D. Thomas is Chairman, has also been appointed, as well as a Local Committee of members from Duluth, Minn.

A circular giving information as to the general programme, transportation, hotel rates, etc., will be issued later.

### ASSISTANT SECRETARY

On February 5th, 1919, Thomas J. McMinn, M. Am. Soc. C. E., retired from the office of Assistant Secretary of the Society, and by vote of the Board of Direction Capt. Stephen L. Coles (late Ordnance Dept., U. S. A.) was appointed to that office.

Mr. McMinn became Assistant Secretary of the Society in September, 1897, and has devoted himself to the work of the Society for more than twenty-one years. Arrangements have been made by the Board by which Mr. McMinn's valuable experience in Society work will be available for the time necessary to enable Capt. Coles to become familiar with his new duties, after which he will be retired on half-pay.

### ENGINEERING SOCIETIES EMPLOYMENT BUREAU

Engineering Societies Employment Bureau, established December 1st, 1918, as an activity of Engineering Council, is managed by a board made up of the Secretaries of the four Founder Societies, funds for its

maintenance being provided by these Societies. The Bureau already is co-operating with engineering organizations in all parts of the country and with the Professional Section of the United States Employment Bureau. It is desirous of increasing such co-operation by working with local engineering associations and clubs. The work of the Bureau since its inception has been largely in the line of securing employment for men retiring from government war service. Members of the American Society of Civil Engineers who desire to register with this Bureau should apply for further information, registration forms, etc., to Walter V. Brown, Manager, Engineering Societies Employment Bureau, 16th Floor, Engineering Societies Building, 29 West 39th Street, New York City.

## SEARCHES IN THE LIBRARY

In January, 1902, the Secretary was authorized to make searches in the Library, upon request, and to charge therefor the actual cost to the Society for the extra work required. Since that time many searches have been made, and bibliographies and other information on special subjects furnished.

The resulting satisfaction to the members who have made use of the resources of the Society in this manner has been expressed frequently, and leaves little doubt that, if it were generally known to engineers that such assistance could be had, many would avail themselves of it.

On October 1st, 1916, the Library of the American Society of Civil Engineers ceased to exist as such, and was merged in the Engineering Societies Library, adding 67 000 volumes to the collection, which comprises also the former libraries of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, and now has a total of 140 000 volumes and pamphlets. Containing, as the Library now does, the special collections mentioned, its scope is broadened, and, as it receives an unusually large number of technical periodicals, it is well equipped to continue the service formerly rendered by the Society Library.

The Engineering Societies Library offers this service at a cost which is trifling compared with the value of the time of an engineer who personally looks up such matters, and the work can be performed quite as well, and much more quickly, by persons familiar with the Library.

In asking that such work be undertaken, members should specify clearly the subject to be covered, and whether references to general books only are desired, or whether a complete bibliography, involving search through periodical literature, is desired.

It sometimes happens that references are found which are not readily accessible to the person for whom the search is made. In that case the Library is prepared to furnish photographic copies of the

material at a small price per page. This method is particularly useful when there are drawings or figures in the text, which would be very expensive to reproduce by hand.

The Library is also able to provide translations of articles in foreign languages when desired.

**Requests for searches, copies, translations, etc., should be addressed to the Director, Engineering Societies Library, 29 West 39th Street, New York City, who will gladly give information concerning the charges for the various kinds of service.**

## PAPERS AND DISCUSSIONS

Members and others who take part in the oral discussions of the papers presented are urged to revise their remarks promptly. Written communications from those who cannot attend the meetings should be sent in at the earliest possible date after the issue of a paper in *Proceedings*.

All papers accepted by the Publication Committee are classified by the Committee with respect to their availability for discussion at meetings.

Papers which, from their general nature, appear to be of a character suitable for oral discussion will be published as heretofore in *Proceedings*, and set down for presentation to a future meeting of the Society, and, on these, oral discussions, as well as written communications, will be solicited.

All papers which do not come under this heading, that is to say, those which from their mathematical or technical nature, in the opinion of the Committee, are not adapted to oral discussion, will not be scheduled for presentation to any meeting. Such papers will be published in *Proceedings* in the same manner as those which are to be presented at meetings, but written discussions only will be requested for subsequent publication in *Proceedings* and with the paper in the volumes of *Transactions*.

The Board of Direction has adopted rules for the preparation and presentation of papers, which will be found on page 35 of the Year Book for 1919.

## LOCAL ASSOCIATIONS OF MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

### San Francisco Association, Organized 1905.

E. J. Schneider, President; Nathan A. Bowers, Secretary-Treasurer, 502 Rialto Building, San Francisco, Cal.

The San Francisco Association of Members of the American Society of Civil Engineers holds regular bi-monthly meetings, with banquet, and weekly informal luncheons. The former are held at 6 P. M., at the Engineers' Club, 57 Post Street, on the third Tuesday of February,

April, June, August, October, and December, the last being the Annual Meeting of the Association.

Informal luncheons are held at noon, every Wednesday, at the Engineers' Club, where special tables are reserved for members and guests of the Association.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in San Francisco, and any such member will be gladly welcomed as a guest.

(Abstract of Minutes of Meeting)

**January 6th, 1919. (Special Meeting.)**—The meeting was called to order at 7.50 P. M., at the Engineers' Club; President Schneider in the chair; H. D. Dewell, Secretary, *pro tem.*; and present, also, 27 members.

The President stated the purpose of the meeting to be the consideration of the proposed law for licensing engineers.

Mr. Snyder, Chairman of the Joint Committee which had drafted the law, reported that the Committee, consisting of Messrs. Grunsky, Dockweiler, and himself, had conferred with committees representing local sections of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers, and it was decided to begin with the act originally drafted by the Parent Societies in 1915, which it was found possible to revise to suit the needs of California. After much discussion and careful study of all sections, the bill was finally put into a shape agreeable to all members of the Committee. He stated, further, that the Committee had concluded that about 100 engineers would take out licenses for each year after the first year's operation of the law. This, under the fees provided for, would give an annual income of $2 500, which would probably be insufficient for the operation of the act, at least for the first few years. He estimated that in the first year about 800 engineers would be granted licenses, and this would produce an income of about $20 000, which could be drawn upon during the next few years succeeding. He estimated that the expenses of operation of the act would be about $3 000 per year.

There followed a detailed discussion of the bill, section by section. In response to an inquiry as to the status of an engineer from an outside State, as in the case of expert examinations and reports, Mr. Snyder explained that the proposed act would allow an outside engineer to operate in the State until his application for license was acted on, the procedure merely being that he apply for license and pay the required application fee of $5.

General discussion brought out the fact, contrary to the ideas of one or two, that the operations of architects were not to be hindered in any way. This was put clearly on record, in order to deny the suggestion that the main purpose of the proposed act was to prohibit the architect from doing engineering work, that is, to compel an architect to employ an engineer to design the structural features of his buildings.

Mr. Snyder stated that a letter-ballot had been sent to all members, giving them the opportunity to vote on the question of presenting the proposed license law to the Legislature, and, although a comparatively small number of replies had been received, the majority was strongly

in favor of presenting it. During the discussion a telephone message was received from Mr. Bowers, in Los Angeles, reporting that the Los Angeles Chapter of the American Institute of Architects had stated that they would not present a bill on licensing to the Legislature this year. The sense of the meeting was that that statement should not affect the attitude of the Association in the matter.

The Board of Directors was authorized to expend such of the Association funds as might be necessary to cover the expenses of the Committee in presenting the bill to the Legislature in Sacramento.

Adjourned.

**Colorado Association, Organized 1908.**

L. R. Hinman, President; A. N. Miller, Secretary-Treasurer, 1400 West Colfax Avenue, Denver, Colo.

The meetings of the Colorado Association of Members of the American Society of Civil Engineers (Denver, Colo.) are held on the second Saturday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary. The meetings are usually preceded by an informal dinner. Members of the American Society of Civil Engineers will be welcomed at these meetings.

Weekly luncheons are held on Wednesday at 12.30 P. M., at Daniels and Fisher's.

Visiting members are urged to attend the meetings and luncheons.

(Abstract of Minutes of Meetings)

**January 21st, 1919.**—The meeting was called to order at the Denver Athletic Club; President L. R. Hinman in the chair; A. N. Miller, Secretary; and present, also, 9 members and 8 guests.

The minutes of the meeting of December 21st, 1918, were read and approved.

The resignation of Mr. J. Y. Jewett was read and accepted with regret.

Mr. Oliver T. Reedy, Construction Engineer of the U. S. Reclamation Service, addressed the meeting on "The Design and Construction of the Grand River (Roller Crest) Dam", illustrating his remarks with lantern views.

Adjourned.

**February 8th, 1919.**—The meeting was called to order at the Denver Athletic Club; President L. R. Hinman in the chair; A. N. Miller, Secretary; and present, also, 10 members and 3 guests.

The minutes of the meeting of January 21st, 1919, were read and approved.

A communication from the Duluth Association relative to the exchange with that Association of resolutions sent to the Parent Society by Local Associations was read. On motion, duly seconded, it was decided to comply with the request.

Professor Milo S. Ketchum outlined his work in connection with the Government Explosives Plant at Nitro, W. Va. His remarks were preliminary to a more complete survey which he promised to present later.

President Hinman reported correspondence with Lt.-Col. H. S. Crocker, and announced that a joint meeting of Engineering Organizations would be held at some future date, at which Col. Crocker would describe his work in constructing the U. S. Army Supply Base at Brooklyn, N. Y.

Mr. Walter L. Drager read a paper on the "Federal Ownership of Railroads." The subject was discussed by Messrs. Comstock, Ridgway, Ketchum, and Prince.

Adjourned.

**Atlanta Association, Organized 1912.**

T. P. Branch, President; J. T. Wardlaw, Secretary-Treasurer, 1530 Healey Bldg., Atlanta, Ga.

Informal luncheons are held for members of the Association on the last Monday of each month, at 12.30 P. M. The place is not fixed, but this information will be furnished on application to the Secretary.

**Baltimore Association, Organized 1914.**

H. G. Perring, President; Charles J. Tilden, Secretary-Treasurer, The Johns Hopkins University, Baltimore, Md.

**Cleveland Association, Organized 1914.**

F. D. Richards, President; George H. Tinker, Secretary-Treasurer, 516 Columbia Building, Cleveland, Ohio.

(Abstract of Minutes of Meeting)

**February 19th, 1919.**—The meeting was called to order at 12.15 P. M. in the rooms of the Cleveland Engineering Society; President F. D. Richards in the chair; George H. Tinker, Secretary; and present, also, 25 members and guests.

The minutes of the meeting of January 4th, 1919, were read and approved.

The President announced that he had appointed Messrs. J. W. Ellms, H. S. Jacoby, and K. H. Osborn, as a committee to confer on closer relations with the Cleveland Engineering Society.

The Secretary presented communications from the Secretary of the Society, and also a resolution by the St. Louis Association.

On motion, duly seconded, it was ordered that the Director from District No. 6 be requested to ascertain and report what the National Societies are doing in regard to the support of the National Service Committee.

On motion, duly seconded, it was ordered that the Director from District No. 6 be requested to endeavor to secure the passage of a resolution by the Board of Direction fixing a date when the term of office of the Chairman and Executive Committee of the Committee on Development shall expire, and directing that Committee to choose their successors.

Mr. W. P. Brown reported on the meeting of the Ohio Association of Technical Societies and the proposed bill for licensing engineers. The matter was discussed by Messrs. Leffler, Tinker, Gascoigne, Thomson, Moomaw, Evans, Poe, and Blaser.

On motion, duly seconded, the President was authorized to appoint a Legislative Committee to examine and criticise the revised draft of the bill for licensing engineers, and advise the Legislative Committee of the Ohio Association of Technical Societies of its findings. The President appointed Messrs. B. R. Leffler, W. P. Brown, and F. A. Pease on this Committee.

Adjourned.

**Detroit Association, Organized 1916.**

T. A. Leisen, President; Clarence W. Hubbell, Secretary, 2348 Penobscot Building, Detroit, Mich.

The regular meetings of the Association are held on the second Friday of December, April, and October, the last being the Annual Meeting.

**District of Columbia Association, Organized 1916.**

A. P. Davis, President; John C. Hoyt, Secretary-Treasurer, U. S. Geological Survey, Washington, D. C.

**Duluth Association, Organized 1917.**

W. B. Patton, President; Walter G. Zimmermann, Secretary, Wolvin Building, Duluth, Minn.

The regular meetings of the Association are held at noon on the third Monday of each month (usually at the Kitchi Gammi Club), with luncheon, followed by a short business session and the reading of papers. Visiting members of the American Society of Civil Engineers can secure from the Secretary definite information relative to the meetings, at which they will be welcomed. The Annual Meeting is held on the third Monday in May.

(Abstract of Minutes of Meeting)

**February 17th, 1919.**—The meeting was called to order at the Kitchi Gammi Club; President Patton in the chair; Walter G. Zimmermann, Secretary; and present, also, 22 members and 3 guests.

The minutes of the meeting of January 27th, 1919, were read and approved.

Letters from several Local Associations were read; they indicated that the suggestion of this Association in regard to exchange of resolutions between Local Associations, was meeting with approval.

A letter from the St. Louis Association containing a resolution regarding the matter of working funds for Engineering Council was referred to a committee consisting of Messrs. Hoyt, Lewis, and Coe.

Two letters from W. N. Jones, Secretary of the Northwestern Association, in reference to the Annual Convention, were referred to the Committee on Arrangements.

A letter from the Secretary of the Society, in answer to the resolution adopted by the Association, pertaining to the Joint Engineering Congress in Paris, was read, but no action was taken.

Mr. Lewis was appointed to arrange for temporary space in the Public Library for an engineering library.

Lieut. George Bryan, Jr., gave an interesting talk on his experiences in Army Engineering Camp life at Camp A. A. Humphreys, Va.

A paper entitled "Hydrated Lime and Its Use in Concrete" was read by Mr. W. E. Hawley, and Messrs. Taylor, Clapper, and Coe were appointed as a committee to lead the discussion at the next meeting.

The President announced that Col. Pope had offered to give a talk at the next meeting.

Adjourned.

**Illinois Association, Organized 1916.**

H. J. Burt, President; Edgar S. Nethercut, Secretary-Treasurer, 1735 Monadnock Blk., Chicago, Ill.

The regular meetings of the Association are held on the second Monday of March, June, September, and December, the last being the Annual Meeting. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

(Abstract of Minutes of Meeting)

**January 20th, 1919.**—The meeting was called to order at 1.15 P. M. in the rooms of the Western Society of Engineers; President Baldwin in the chair; E. S. Nethercut, Secretary; and present, also, 20 members.

The President announced that this was the adjourned Annual Meeting, and the order of business would be the receipt of reports and the election of officers for the ensuing year.

The Treasurer's report was presented, and on motion, duly seconded, was approved and placed on file.

The Secretary reported a paid-up membership of 94 members, 29 of whom were admitted during 1918.

The following officers for 1919 were elected: President, H. J. Burt; Vice-President, C. B. Burdick; Secretary-Treasurer, Edgar S. Nethercut.

Onward Bates, Past-President, Am. Soc. C. E., Chairman of the Committee on Development, reported on the appointment of the Committee and its first or organization meeting, held in Chicago last November, at which the Executive Committee and a number of Sub-committees had been appointed, and stated that the work is now being carried on by these Sub-committees. He requested that members of the Society advise the Committee of any suggestions that they may have with regard to matters which might be taken up.

Mr. W. H. Woodbury, of the Duluth Association, outlined the activities of the Duluth members with reference to the Committee on Development.

Messrs. C. L. Strobel and C. F. Loweth reported on the proceedings of the Society at the Annual Meeting, and this was followed by a general discussion of the affairs of the Illinois Association and plans for the future.

Mr. E. S. Nethercut, the Association's member on the Committee on Development, mentioned several important questions which should be considered, among them the following:

The relations between the Local Association and similar associations of the other National Societies.

Membership in the Local Association as well as in the National Society.

Should arrangements be made to present papers before the Local Association as well as before the National Society?

Is it possible to have one National Engineering Society, or is it desirable?

On motion, duly seconded, the Secretary was instructed to draw up a set of questions to be sent to the members of the Association, with a request that they discuss them, in writing, for the benefit of the Committee on Development.

The Secretary called attention to the action of the Executive Committee of the War Committee of Technical Societies of Chicago, in suggesting a change in the name and activities of that Committee on account of the cessation of war, the new name to be the General Committee of Technical Societies of Chicago, and the purpose, to advance the interests of the engineer and to promote the welfare of the public and the technical professions. On motion, duly seconded, the change in name and purpose was approved.

The President appointed Mr. A. Yappen a committee of one to advise Maj. H. J. Burt of his election as President.

Adjourned.

**Louisiana Association, Organized 1914.**

Arsène Perrilliat, President; Eugene F. Delery, Secretary, 2007 Laharpe Street, New Orleans, La.

The regular meetings of the Association are held at The Cabildo, New Orleans, La., on the first Monday of January, April, July, and October.

**Nebraska Association, Organized 1917.**

Adna Dobson, President; Homer V. Knouse, Secretary-Treasurer, 109 City Hall, Omaha, Nebr.

Regular meetings of the Association are held on the first Saturday of each month, except July and August, and at such places as may be appointed from time to time by the Executive Committee. The Annual Meeting is held in Lincoln, Nebr., on the second Friday in January.

Visiting members of the Society are especially urged to communicate with the Secretary when in the city.

**Northwestern Association, Organized 1914.**

Ralph D. Thomas, President; W. N. Jones, Secretary, City Engineer's Office, City Hall, Minneapolis, Minn.

The meetings of the Association are held bi-monthly, alternating between St. Paul and Minneapolis, on the third Friday of each month. Information as to the time and place of such meetings will be furnished on application to the Secretary.

**Philadelphia Association, Organized 1913.**

F. Herbert Snow, President; Henry T. Shelley, Secretary, 416 City Hall, Philadelphia, Pa.

The regular meetings of the Association are held at the Engineers' Club of Philadelphia, 1317 Spruce Street, on the first Monday in January, April, and October, the last being the Annual Meeting.

(Abstract of Minutes of Meeting)

**January 6th, 1919.**—The meeting was called to order at 8.30 P. M. at the Engineers' Club; President Snow in the chair; H. T. Shelley, Secretary; and present, also, about 100 members and guests.

Past-President Samuel T. Wagner introduced Mr. F. Herbert Snow, the newly elected President, and Mr. Snow made an appropriate address.

Mr. Calvin W. Rice, Secretary of the American Society of Mechanical Engineers, and Mr. S. M. Swaab, Treasurer of the Philadelphia Association, addressed the meeting on "The Relation of the Engineer to the Community and the Value of the Society to the Engineer." The subject was discussed by Messrs. John Meigs, Charles F. Puff, Jr., John W. Ledoux, M. Ward Easby, Benjamin Franklin, Richard L. Humphrey, Samuel T. Wagner, George S. Webster, C. B. Voynow, and Charles Hansel.

Mr. Humphrey recommended that a meeting of the Association be held in the latter part of January, or early in February, for the purpose of discussing the work of the Committee on Development.

On motion, duly seconded, the President was authorized to appoint a committee to consider the addresses and discussions of the evening, the Annual Address of the President of the Society, and the Preliminary Report of the Committee on Development, with a view to the creation of various committees to be appointed by the President of the Association to consider specific subjects mentioned in these addresses, discussions, and report, and to recommend to the Board of Directors such committees and the scope of the work of each, as such committee may deem advisable.

The minutes of the meeting of October 7th, 1918, were read and approved. The report of the Auditing Committee was read and approved. A communication from the Duluth Association was read and accepted.

Adjourned.

**February 3d, 1919. (Special Meeting.)**—The meeting was called to order at 8.30 P. M. at the Engineers' Club; President Snow in the chair; H. F. Shelley, Secretary; and present, also, about 50 members.

The Secretary presented a resolution from the St. Louis Association favoring a voluntary contribution of one dollar per member per year for a period of three years by all the members of the Society for the use of the National Service Committee and for such additional purposes as may be approved by Engineering Council.

The resolution was accepted by the Association and referred to the Board of Directors for consideration.

The President announced the membership of the committees created by the Board of Directors and the Association.

On motion, duly seconded, it was decided that the Association's Committee on Development be asked to report at a meeting to be called on March 3d, 1919.

On motion, duly seconded, it was decided to appoint four members, in addition to the Chairman, already selected, to the following Committees:

Technical Activities (Mr. C. B. Voynow, Chairman).

Internal Relations and Local Association (Mr. John A. Vogleson, Chairman).

External Relations with the Engineering Profession (Mr. Emile G. Perrot, Chairman).

Public Affairs (Mr. M. Ward Easby, Chairman).

Mr. Benjamin Franklin was appointed Chairman of the Committee on Development of the Association.

Mr. R. L. Humphrey, member of the Committee on Development, addressed the meeting on the work of that Committee, setting forth the problems confronting it, giving prominence to the salient features, and outlining a procedure which would create a definite policy and eventually terminate in a recommendation which will make it possible for the Society to satisfy the demands of its membership that its endeavor be extended to new, larger, and more progressive fields.

Messrs. Fisher, Wagner, Swaab, and Perrot took part in the discussion.

Adjourned.

**Pittsburgh Association, Organized 1917.**

Robert A. Cummings, President; Nathan Schein, Secretary-Treasurer, 1510 Carson Street, Pittsburgh, Pa.

The Annual Meeting of the Association is held on the first Monday in October. The time and place of other meetings are not fixed, but this information will be furnished on application to the Secretary.

**Portland, Ore., Association, Organized 1913.**

E. Burslem Thomson, President; C. P. Keyser, Secretary, 318 City Hall, Portland, Ore.

**St. Louis Association, Organized 1888 (Constitution Approved by Board, 1914).**

J. A. Ockerson, President; C. W. S. Sammelman, Secretary-Treasurer, 300 City Hall, St. Louis, Mo.

The Annual Meeting of the Association, for the election of officers and for the transaction of business, is held on the fourth Monday in November. Two meetings each year, for the presentation and discussion of technical papers, are held in the Auditorium of the Engineers Club of St. Louis and are open to members of the Associated Societies. Other "get-together" meetings are held regularly for dinner or luncheon on the fourth Monday of each month except July, August, and November.

(Abstract of Minutes of Meeting)

**January 27th, 1919.**—The meeting was called to order at 12.45 P.M.; President J. A. Ockerson in the chair; C. W. S. Sammelman, Secretary; and present, also, 24 members.

The minutes of the previous meeting were read and approved.

The resignation of Mr. T. C. Moorshead as a member of the Association was received and accepted.

On motion, duly seconded, the Association concurred in the resolutions of the Duluth Association relative to the geographical location of members of Committees.

On motion, duly seconded, a letter from the Duluth Association relating to the formation of an Engineering Society composed of all branches of engineering, was referred to Messrs. B. L. Brown and E. E. Wall for report.

On motion, duly seconded, the following resolution was adopted:

"*Whereas,* we are informed that the work of Engineering Council is being seriously hampered on account of inability of the four founder societies to supply the Council with sufficient funds; and,

"*Whereas,* we are informed that Engineering Council is without any funds whatever for the maintenance in Washington of the newly established National Service Committee, the proposed work of which is considered of the very greatest importance to the Engineering Profession; therefore,

"*Be it Resolved,* That the St. Louis Association of Members declares itself in favor of a voluntary contribution of one dollar per member per year for a period of three years by all of the members of the American Society of Civil Engineers for the use of the National Service Committee, and for such additional purposes as may be approved by Engineering Council; and

"*Be it Further Resolved,* That a copy of this Resolution be sent to each local association of the American Society of Civil Engineers suggesting similar action on their part, and that the Board of Direction of this Society bring before the other national societies through Engineering Council a request for similar action on the part of their membership."

Mr. E. E. Wall reported briefly relative to the Annual Meeting of the Society.

Adjourned.

**San Diego Association, Organized 1915.**

W. C. Earle, President; Ralph Wueste, Secretary-Treasurer, Bonita, Cal.

**Seattle Association, Organized 1913.**

L. M. Grant, President; Phil A. Franklin, Secretary, 1409 East 65th St., Seattle, Wash.

The regular meetings of the Association, with luncheon, are held at the Engineers' Club, Arctic Building, Third Avenue and Cherry Street, at 12.15 P. M., on the last Monday of each month.

Special evening meetings are held from time to time for the purpose of discussing important topics, and information concerning these meetings may be had by addressing the Secretary. All members in any grade of the American Society of Civil Engineers are cordially invited to attend the meetings when in the vicinity, and, if located in this District for any length of time, their membership in the Association will be appreciated.

**Southern California Association, Organized 1914.**

George G. Anderson, President; Floyd G. Dessery, Secretary, 514 Central Building, Los Angeles, Cal.

The Southern California Association of Members of the American Society of Civil Engineers (Los Angeles, Cal.) holds regular monthly meetings on the second Wednesday of each month, the December meeting being the Annual Meeting.

Informal luncheons in connection with the Joint Technical Societies of Los Angeles are held at 12.15 P. M. every Thursday at the Broadway Department Store Café.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in Los Angeles, and any such member will be gladly welcomed as a guest at any of the meetings or luncheons.

(Abstract of Minutes of Meeting)

**February 12th, 1919.**—The meeting was called to order at Christopher's at 7.30 P. M.; President George G. Anderson in the chair; F. G. Dessery, Secretary; and present, also, 28 members and 6 guests.

The Secretary announced the personnel of the several committees appointed, as follows:

On Programme: W. K. Barnard, Chairman, A. L. Sonderegger, and E. L. Adams.

On Reconstruction and Development: F. E. Trask, Chairman, W. H. Code, F. H. Olmsted, A. C. Hansen, H. Z. Osborne, Jr., and F. G. Dessery.

On Entertainment: H. Hawgood, Chairman, T. D. Allin, and H. E. Warrington.

On Joint Technical Societies: C. T. Leeds, Chairman, W. K. Barnard, George G. Anderson, and F. G. Dessery.

On Licensing Engineers: E. T. Flaherty, Chairman, E. R. Bowen, B. Moody, S. B. Morris, and Franklin Thomas.

The Secretary read a communication from the Secretary of the Society, stating the attitude of the Board of Direction in relation to the Committee on Development, as involved in the matters mentioned in the resolution of the Duluth Association, which resolution was also presented to the meeting. The President, as the representative of the Southern California Association, reported in detail the considerations which had led to the abandonment of the meeting of the Committee in New York at the time of the Annual Meeting, as shown by the various communications received by the members of the Committee, and then commented on the status of the work since the Chicago meeting. General discussion by the members followed, in the course of which great interest in the importance of the Committee's work was manifested and disappointment expressed in the progress made.

On motion, duly seconded, it was decided to appoint a committee of three to report to the Board of Directors on the general instructions contained in a motion (duly seconded) expressing this Association's conclusion that the work before the Committee on Development is of paramount importance, that the time is opportune for consideration and determination of the problems involved, that unnecessary delay has occurred and was likely to continue, that every facility should be

granted the Committee and every influence used to urge the officials to expedite the work, and that copies of the resolution be sent to the President and Board of Direction of the Society, the Chairman, and all members of the Committee on Development, and to all Local Associations.

Subsequently, President Anderson appointed Messrs. Barnard, Chairman, Bowen, and Olmsted as such committee, and it submitted the following resolution:

"*Whereas:* The problems submitted by the Society to the Committee on Development are of the most vital and far reaching consequence to the Society and, in view of their importance and the opportune nature of these present times, and the imperative necessity for their immediate consideration and determination, the progress of the work of the Committee should be as speedy as is consistent with thorough deliberation; and

"*Whereas:* It is the sense of this Association that much unnecessary delay has already been caused, and that, from present indications, the continuation of such delay seems probable, to the disappointment of the large body of the members who have confidently hoped for early and beneficial results from the labors of the Committee; therefore, be it

"*Resolved:* That the Southern California Association of Members of the American Society of Civil Engineers considers the work to be performed by the Committee on Development to be paramount to any enterprise or undertaking in which the American Society of Civil Engineers is now engaged; and, be it further

"*Resolved:* That every facility and encouragement should be given the Committee on Development in its work, and that the officers of the Society and of the Committee urge the expedition of the deliberation; and, be it further

"*Resolved:* That a copy of these resolutions be sent to the President and Board of Direction of the American Society of Civil Engineers, and to the Chairman and all Members of the Committee on Development, and to all Local Associations of Members of the American Society of Civil Engineers."

Mr. Flaherty, Chairman of the Committee on Licensing Engineers, presented a report on the "Draft of a Proposed Act for the Registration of Professional Engineers in California," adopted by the San Francisco Association and approved by Committees of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Pacific Coast Association of Consulting Engineers.

The report of the Committee stated its conclusions as to the several sections, and recommended the adoption of the Act if rewritten, corrected, and amended.

Following a long discussion, it was moved, seconded, and carried, that the report of the Committee be placed on file, and that the Committee continue its labors and considerations, with the thanks of the Association for the services rendered.

On motion, duly seconded, the sense of the meeting was expressed in favor of the principle of legislation to license or register professional

engineers in California, and of inviting a conference with the San Francisco Committee, the Joint Committee of the Technical Societies of Los Angeles, and the Committee on Licensing Engineers of this Association, with the view of reconsidering the proposed Act and of drafting such a measure as will meet with the approval of the members of the various engineering organizations.

The Chairman of the Programme Committee outlined the plans of his Committee for a symposium on "Flood Control in Southern California."

The Secretary presented a communication from the Duluth Association requesting the exchange of copies of all resolutions addressed to the Parent Society. It was decided to comply with this request.

The President announced that, in view of the plans of the Programme Committee, the meetings of the Association hereafter will be held monthly, in place of bi-monthly.

Adjourned.

**Spokane Association, Organized 1914.**

Peter Morgensen, President; Charles E. Davis, Secretary, City Engineer's Office, Spokane, Wash.

The regular meetings of the Association are held on the second Friday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

Visiting members are invited to attend the meetings.

**Texas Association, Organized 1913.**

R. J. Potts, President; J. H. Brillhart, Secretary, Care, Mosher Mfg. Co., Dallas, Tex.

**Utah Association, Organized 1916.**

A. B. Villadsen, President, 304 Dooly Block, Salt Lake City, Utah.

The Annual Meeting of the Association is held on the first Wednesday in April. The time of other meetings is not fixed, but this information will be furnished on application to the President.

## PRIVILEGES OF ENGINEERING SOCIETIES EXTENDED TO MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Members of the American Society of Civil Engineers will be welcomed by the following Engineering Societies, both to the use of their Reading Rooms, and at all meetings:

**American Institute of Electrical Engineers,** 25 West Thirty-ninth Street, New York City.

**American Institute of Mining Engineers,** 25 West Thirty-ninth Street, New York City.

**American Society of Mechanical Engineers,** 25 West Thirty-ninth Street, New York City.

**Asociación de Ingenieros y Arquitectos de Mexico,** Avenida Juarez, 12, City of Mexico, Mexico.

**Assogiacão dos Engenheiros Civis Portuguezes,** Lisbon, Portugal.

**Australasian Institute of Mining Engineers,** Melbourne, Victoria, Australia.

**Boston Society of Civil Engineers,** 715 Tremont Temple, Boston, Mass.

**Brooklyn Engineers' Club,** 117 Remsen Street, Brooklyn, N. Y.

**Civil Engineers' Society of St. Paul,** Public Library, St. Paul, Minn.

**Cleveland Engineering Society,** Chamber of Commerce Building, Cleveland, Ohio.

**Cleveland Institute of Engineers,** Middlesbrough, England.

**Dansk Ingeniorforening,** Amaliegade 38, Copenhagen, Denmark.

**Detroit Engineering Society,** Detroit Board of Commerce Building, Detroit, Mich.

**Engineering Association of Nashville,** Commercial Club Building, Nashville, Tenn.

**Engineering Association of New South Wales,** 5 Elizabeth Street, Sydney, New South Wales, Australia.

**Engineering Institute of Canada,** 176 Mansfield Street, Montreal, Que., Canada.

**Engineering Societies Club of Hawaii,** E. F. Cykler, Secretary, Honolulu, Hawaii.

**Engineers and Architects Association of Southern California,** 405 Hosfield Bldg., Los Angeles, Cal.

**Engineers and Architects Club of Louisville,** 1412 Starks Building, Louisville, Ky.

**Engineers' Club of Baltimore,** 6 West Eager Street, Baltimore, Md.

**Engineers' Club of Kansas City,** Robert S. Beard, Secretary, Third Floor, City Hall, Kansas City, Mo.

**Engineers' Club of Minneapolis,** 17 South Sixth Street, Minneapolis, Minn.

**Engineers' Club of Philadelphia,** 1317 Spruce Street, Philadelphia, Pa.

**Engineers' Club of St. Louis,** 3817 Olive Street, St. Louis, Mo.

**Engineers' Club of Toronto,** 96 King Street, West, Toronto, Ont., Canada.

**Engineers' Club of Trenton,** Trent Theatre Building, 12 North Warren Street, Trenton, N. J.

**Engineers' Society of Northeastern Pennsylvania,** 415 Washington Avenue, Scranton, Pa.

**Engineers' Society of Pennsylvania,** 31 South Front Street, Harrisburg, Pa.

**Engineers' Society of Western Pennsylvania,** 568 Union Arcade Building, Pittsburgh, Pa.

**Florida Engineering Society,** J. R. Benton, Secretary, Gainesville, Fla.

**Institute of Marine Engineers,** The Minories, Tower Hill, London, E., England.

**Institution of Civil Engineers,** Great George Street, Westminster, S. W., London, England.

**Institution of Engineers of the River Plate,** Calle 25 de Mayo 195, Buenos Aires, Argentine Republic.

**Institution of Mechanical Engineers,** 11 Great George Street, London, S. W. 1, England.

**Institution of Naval Architects,** 5 Adelphi Terrace, London, W. C., England.

**Junior Institution of Engineers,** 39 Victoria Street, Westminster, S. W., London, England.

**Koninklijk Instituut van Ingenieurs,** The Hague, The Netherlands.

**Louisiana Engineering Society,** State Museum Building, Chartres and St. Ann Streets, New Orleans, La.

**Memphis Engineers' Club,** Memphis, Tenn.

**Midland Institute of Mining, Civil and Mechanical Engineers,** Sheffield, England.

**Montana Society of Engineers,** Butte, Mont.

**North of England Institute of Mining and Mechanical Engineers,** Newcastle-upon-Tyne, England.

**Oregon Society of Civil Engineers,** Portland, Ore.

**Pacific Northwest Society of Engineers,** 803 Central Building, Seattle, Wash.

**Rochester Engineering Society,** Rochester, N. Y.

**Sociedad Colombiana de Ingenieros,** Bogota, Colombia.

**Sociedad de Ingenieros del Peru,** Lima, Peru.

**Societe des Ingenieurs Civils de France,** 19 rue Blanche, Paris, France.

**Society of Engineers,** 17 Victoria Street, Westminster, S. W., London, England.

**Southwestern Society of Engineers,** C. E. Barglebaugh, Secretary, 703 First National Bank Building, El Paso, Tex.

**Svenska Teknologforeningen,** Brunkebergstorg 18, Stockholm, Sweden.

**Tekniske Forening,** Vestre Boulevard 18–1, Copenhagen, Denmark.

**Vermont Society of Engineers,** George A. Reed, Secretary, Montpelier, Vt.

**Western Society of Engineers,** 1735 Monadnock Block, Chicago, Ill.

# ACCESSIONS TO THE ENGINEERING SOCIETIES LIBRARY

(From February 1st to February 28th, 1919)

## DONATIONS*

**The statements made in these notices are taken from the books themselves, and this Society is not responsible for them.**

THE ELEMENTS OF WOODEN SHIP CONSTRUCTION.

By W. H. Curtis. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 223 pp., 199 illus., 9 x 6 in., cloth. $2.50.

This book is a revised and enlarged edition of a course prepared for the Education and Training Section of the Emergency Fleet Corporation. It is intended for the use of carpenters and others who, though skilled in their work, lack the detailed knowledge of shipbuilding necessary for efficiency.

PRACTICAL SHIP PRODUCTION.

By A. W. Carmichael. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 252 pp., 101 illus., 9 x 6 in., cloth. $3.00.

The purpose of this book is to serve as an introduction to the subject by presenting the most important general principles of ship design and describing the various processes of shipbuilding. The treatment is practical rather than theoretical, and matters of construction are more fully considered than problems of design.

1919 RECORD OF AMERICAN AND FOREIGN SHIPPING, NEW YORK.

Published by the American Bureau of Shipping, "American Lloyds." N. Y., 1919. 1056 pp., 10 x 10 in., morocco.

The 1919 Record presents no change in form from previous years. It provides a record of American and foreign vessels, classified according to the rules of the Bureau, and is endorsed by the Navy Department and the Boards of Marine Underwriters of New York, Boston, and San Francisco. In addition to the list of vessels, there are lists of owners, marine underwriters' representatives, surveyors, machinery constructors, dry docks, marine railways, and ship builders. An index of changed names is also included.

THE RUDDER DIRECTORY:

A Trade List of Shipbuilding and Marine Industries. Compiled and Issued by The Rudder Publishing Company. N. Y., 1919. 332 pp., 1 pl., 9 x 6 in., cloth. $5.00.

Included in this directory are lists of the steel, wood, composite, and concrete shipyards, with the names of their officers, ship and engine repair plants, dry docks and marine railways, owners and operating companies, marine insurance companies, boat builders, engine builders, ship chandlers and manufacturers of equipment, parts, etc. A supplement, revised to February 6th, 1919, brings the data concerning the U. S. Shipping Board and the Emergency Fleet Corporation up to date.

PETROLEUM REFINING.

By Andrew Campbell, with a Foreword by Sir Boverton Redwood. Lond., Charles Griffin & Co., Ltd., 1918. 297 pp., 138 illus., 29 folding pl., 3 diag., 11 tab., 9 x 6 in., cloth. $8.50.

This volume, the only book in English devoted solely to the subject, describes the ordinary methods used to prepare marketable products from petroleum, except "cracking" methods. The work is based on extended practical experience, is well supplied with illustrations and drawings, and includes a bibliography.

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*Unless otherwise specified, books in this list have been donated by the publishers.

**FIGHTING THE BOCHE UNDERGROUND.**

By H. D. Trounce. N. Y., Charles Scribner's Sons, 1918. 234 pp., 7 pl., 1 por., 1 diag., 8 x 5 in., ¼ cloth. $1.50. (Gift of Author.)

Captain Trounce, an American mining engineer, enlisted in the Royal Engineers in 1915, and transferred to the Engineer Reserve Corps of the American Army in 1917. His book is a description of the underground fighting in which he participated in Flanders, at Arras, Vimy Ridge, and elsewhere.

**INDUSTRY AND HUMANITY:**

A Study of the Principles Underlying Industrial Reconstruction. By W. L. Mackenzie King. Boston and N. Y., Houghton, Mifflin Company, 1918. 567 pp., 10 charts, 8 x 6 in., cloth. $3.00.

This volume, by the former Minister of Labor of Canada, is a statement of the underlying principles which are finding expression in the organization of industrial society and which should obtain in all efforts at reconstruction. The book is based on the author's twenty years of personal contact with labor problems, supplemented by a study of the literature of the subject.

**THE INSTRUCTOR, THE MAN AND THE JOB:**

A Hand Book for Instructors of Industrial and Vocational Subjects. By Charles R. Allen. Phila. and Lond., J. B. Lippincott Co. (copyright 1919). 373 pp., 8 x 5 in., cloth. $1.50.

The author, who has been Agent for Industrial Training for the Massachusetts Board of Education, and Superintendent of Instructor Training for the Emergency Fleet Corporation, gives the result of his experience in this volume, which is intended as a handbook for instructors in industrial plants and as instruction notes in training courses for instructors.

**INSTINCTS IN INDUSTRY:**

A Study of Working-Class Psychology. By Ordway Tead. Boston and N. Y., Houghton, Mifflin Company, 1918. 222 pp., 8 x 5 in., cloth. $1.40.

With the idea of contributing to a better understanding of people in their capacity as manual workers, Mr. Tead has analyzed in turn the ten basic instincts on which our life and conduct rest, has shown how each affects the worker's relation to his job, and how each must be studied and used in the task of attaining sound relations between the employer and the employed.

**OUR NATIONAL FORESTS:**

A Short Popular Account of the Work of the United States Forest Service on the National Forests. By Richard H. Douai Boerker. N. Y., The Macmillan Company, 1919. 238 pp., 80 illus., 8 x 5 in., cloth. $2.50.

The author presents a well-illustrated account of our National forest problem and of the work of the Forest Service, written in popular form and based largely on his personal experience and observation. Contents: The Creation and Organization of the National Forests; The Administration of the National Forests; The Protection of the National Forests; The Sale and Rental of National Forest Resources; Appendix: Table of Land Areas Within the National Forest Boundaries, June 30, 1917.

**PHYSICS FOR TECHNICAL STUDENTS:**

Sound, Light, Electricity, and Magnetism. By William Ballantyne Anderson. N. Y., McGraw-Hill Book Company, Inc.; Lond., Hill Publishing Co., Ltd., 1919. 794 pp., 373 illus., 9 x 6 in., cloth. $3.00.

This book completes the author's textbook of physics, the first part of which has been published previously under the title, "Mechanics and Sound." The writer has aimed to produce a college text especially suitable for students of agriculture and engineering, in which particular attention is directed to practical applications of the subject.

**THOMAS' REGISTER OF AMERICAN MANUFACTURERS**

And First Hands in All Lines. N. Y., Thomas Publishing Co. (copyright 1919). 4200 pp., 12 x 10 in., cloth. $15.00.

The tenth edition of this well-known trade directory is dated "October" as usual, although corrections were made up to December 20th. The directory is divided into various lists, the chief one being a carefully classified list of manufacturers in all lines, subclassed geographically and provided with an extensive index to the classification. Other lists are of representative banks, boards of trade, chambers of commerce, etc., trade papers, leading trade names, and an alphabetical list of manufacturers. The volume contains 4 200 pages of information, conveniently arranged for quick consultation.

**JOHNSON'S MATERIALS OF CONSTRUCTION.**

Rewritten by M. O. Withey and James Aston. Edited by F. E. Turneaure. 5th edition. N. Y., John Wiley and Sons, Inc.; Lond., Chapman and Hall, Ltd., 1919. 840 pp., illus., 1 pl., 1 por., tab., 9 x 6 in., cloth. $6.00.

As the progress of the past twenty years in the knowledge of the properties of materials made Professor Johnson's book an inadequate account of the subject, it has been rewritten under the editorship of his successor at the University of Wisconsin. The authors have aimed to retain the broad scope of the original work as a statement of the essential information concerning the sources, manufacture or fabrication of the principal materials, their more important mechanical and physical properties, and the influences of various factors on them, the causes of defects and variations, the methods of testing and their general uses. The arrangement of the book is new, and some changes have been made in its scope. Obsolete matter has been eliminated and modern data have been substituted. The volume is intended to serve both as a textbook and as a work of reference.

# SUMMARY OF SOCIETY MEMBERSHIP SERVING IN THE ARMIES AND NAVIES OF THE UNITED STATES AND ITS ALLIES

## March 12th, 1919

### American Army

| | |
|---|---|
| Major-Generals | 9 |
| Brig.-Generals | 18 |
| Colonels | 54 |
| Lt.-Colonels | 56 |
| Majors | 243 |
| Captains | 515 |
| First Lieutenants | 238 |
| Second Lieutenants | 55 |
| Regimental Sergeants | 1 |
| Master Engineers | 8 |
| Master Gunners | 2 |
| Sergeants | 17 |
| Corporals | 9 |
| Privates | 33 |
| Students, Training Camps | 6 |
| Miscellaneous | 3 |
| Total | 1267 |

### British Army

| | |
|---|---|
| Brig.-Generals | 1 |
| Lt.-Colonels | 5 |
| Majors | 10 |
| Captains | 15 |
| Lieutenants | 14 |
| Second Lieutenants | 6 |
| Corporals | 2 |
| Privates | 1 |
| Miscellaneous | 1 |
| Total | 55 |

### French Army

| | |
|---|---|
| Commandant | 1 |
| Captains | 1 |
| Lieutenant | 1 |
| Aspirant | 1 |
| Miscellaneous | 2 |
| Total | 6 |
| Total in Armies | 1328 |

### Summary for Armies

| | |
|---|---|
| Major-Generals | 9 |
| Brig.-Generals | 19 |
| Colonels | 54 |
| Lt.-Colonels | 61 |
| Majors | 253 |
| Commandant | 1 |
| Captains | 531 |
| Lieutenants | 253 |
| Second Lieutenants | 61 |
| Regimental Sergeants | 1 |
| Master Engineers | 8 |
| Master Gunners | 2 |
| Sergeants | 17 |
| Corporals | 11 |
| Privates | 34 |
| Students, Training Camps | 7 |
| Miscellaneous | 6 |
| Total | 1328 |

### American Navy

| | |
|---|---|
| Rear-Admirals | 5 |
| Captains | 6 |
| Commanders | 14 |
| Lt.-Commanders | 14 |
| Civil Engineers (rank not given) | 9 |
| Lieutenants | 29 |
| Lieutenants (Junior Grade) | 8 |
| Ensigns | 11 |
| Asst. Paymaster (rank not given) | 1 |
| Chf. Machinist's Mate | 2 |
| Chf. Carpenter's Mate | 1 |
| Total in Navy | 100 |

### RECAPITULATION

| | |
|---|---|
| Total in Armies | 1328 |
| Total in Navy | 100 |
| Total on Roll of Honor | 1428 |
| Died in Service | 26 |
| Grand Total | 1454 |

## ROLL OF HONOR

**A List of Members of the Society Who are Serving in the Army or Navy of the United States or Any of Its Allies.***

***VANSITTART, GEORGE EDWARD.*** *Maj., 13th Battery, Canadian Field Artillery, 2d Canadian Div.; wounded in action (France); died May 14th, 1916.*

***AGNEW, AUGUSTUS WATEROUS.*** *Capt., 3d Canadian Pioneers; wounded in action (France); died September 17th, 1916.*

***HAGUE, WILLIAM.*** *1st Lieut., Engr. R. C., 116th Engrs.; died in service (France), January 1st, 1918.*

***GOODFELLOW, JAMES GORDON.*** *Maj., Royal Engrs.; killed in action (France), March 23d, 1918.*

***BUCKWALTER, HARRIS DANIEL.*** *Capt., Engr. R. C.; killed in action (France), May 12th, 1918.*

***LINDBERY, CHARLES ARTHUR.*** *Capt., Engr. R. C.; died in service (Camp Lee, Va.), May 27th, 1918.*

***ANNEAR, EDGAR HAROLD.*** *Capt., Engr. R. C.; died in service (Hoboken, N. J.), August 28th, 1918.*

***SLEPPY, KIRBY BALDWIN.*** *Capt., Engineers, U. S. A., 4th Engrs.; killed in action (France), August 4th, 1918.*

***ALEXANDER, EDWARD PORTER.*** *1st Lieut., Engineers, U. S. A., 509th Engrs.; died in service (France), September 5th, 1918.*

***McCLURE, HUNTER.*** *1st Lieut., Engineers, U. S. A., Co. N, 21st Engrs.; died in service (France), September 26th, 1918.*

***REAM, WARD HALL.*** *1st Lieut., Engineers, U. S. A., Co. C, 305th Engrs.; killed in action (France), October 4th, 1918.*

***DEDICKE, ERNEST CHARLES.*** *1st Lieut., U. S. A.; wounded in action (France); died July 15th, 1918.*

***DEAN, STANLEY.*** *Capt., Quartermaster Corps, U. S. A.; died in service (Camp Humphreys, Va.), October 2d, 1918.*

***PECK, MYRON HALL.*** *Capt., Engineers, U. S. A., 2d Engrs.; killed in action (France), October 9th, 1918.*

***HONEYMAN, BRUCE RITCHIE.*** *Capt., Engineers, U. S. A., Co. A, 313th Engrs.; died in service (France), October 15th, 1918.*

***MILLS, ADELBERT PHILO.*** *Capt., Engineers, U. S. A.; died in service (France), October 20th, 1918.*

***PRITCHETT, FREDERICK BORRADAILE.*** *Lieut., U. S. A., 109th F. A., Headquarters Co., 28th Div.; wounded in action (France); died September 6th, 1918.*

***MURRAY, JAMES POWELL.*** *Capt., Engineers, U. S. A.; died in service (Austin, Tex.), September 28th, 1918.*

***JONES, GRANDVILLE REYNARD.*** *Capt., Sanitary Corps, U. S. A.; died in service (Camp Benning, Ga.), December 22d, 1918.*

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* This list is made up from replies to a circular forwarded to members of the Society, and others, and is probably neither accurate nor complete. It is requested that the attention of the Secretary be called to any omissions or inaccuracies in order that they may be corrected in subsequent lists.

***BELL, VICTOR HUGO.*** *M. S. E., Meteorological Detachment, Signal Corps, U. S. A.; died in service (Arcadia, Cal.), January 6th, 1919.*

***REILLY, CHARLES GILBERT.*** *Capt., U. S. A., Co. D, 313th Inf.; killed in action (France), October 1st, 1918.*

***MARRIAN, RALPH RICHARDSON.*** *2d Lieut., U. S. A., Co. B, 105th Engrs.; killed in action (France), October 17th, 1918.*

***SLIFER, HIRAM JOSEPH.*** *Lt.-Col., U. S. A., 21st Engrs. (Light Ry.); died in service (France), February 3d, 1919.*

***OSTRUP, JOHN CHRISTIAN.*** *Maj., Engineers, U. S. A.; died in service (New York City), February 27th, 1919.*

***HAZLEHURST, JAMES NISBET.*** *Maj., Engineers, U. S. A.; died in service (France), February 9th, 1919.*

***HALCOMBE, NORMAN MARSHALL.*** *Capt., Royal Flying Corps (British); died in service (Port Said, Egypt), February 12th, 1919.*

**Abbot, Frederic V.** Brig.-Gen., Engineers, U. S. A.

**Abbot, Frederick William.** Lt.-Col., British Army.

**Acher, A. H.** Col., Engineers, U. S. A., A. E. F., France.

**Acker, Robert L.** Corporal, Headquarters Co., 7th F. A., A. E. F., France.

**Ackerman, Alexander S.** Capt., Engineers, U. S. A., A. E. F., France.

**Adams, Arthur.** Lt.-Col., Ordnance, U. S. A.

**Adams, Edward M.** Maj., U. S. A.

**Adams, Milton Jewell.** Capt., Engineers, U. S. A., Co. C, 114th Engrs.

**Adams, Raymond E.** Capt., Quartermaster Corps, U. S. A.

**Adams, Walter Francis.** Sergeant, Co. E, 2d Bn., 23d Engrs., A. E. F., France.

**Adams, William H.** Capt., Quartermaster Corps, U. S. A.

**Albert, Frederick W.** Lt.-Col., Engineers, U. S. A., 33d Engrs., A. E. F., France.

**Alden, Herbert C.** 1st Lieut., Coast Artillery, U. S. A.

**Alden, Langford Taylor.** Aspirant, 7e Batterie, 51st Regt. d'Artillerie, Secteur Postal No. 82 (French Army); Care, Morgan, Harjes Cie., Boulevard Haussmann, Paris, France.

**Alderman, Ernest S.** Lieut., Quartermaster Corps, U. S. A.

**Alexander, Kay.** Maj., 12th Canadian Ry. Troops, B. E. F., France.

**Allen, Franklin R.** Capt., Engineers, U. S. A., 603d Engrs., A. E. F., France.

**Allen, Herschel Heathcote.** Capt., Engineers, U. S. A.

**Allen, Ralph B.** 1st Lieut., Engineers, U S. A., Co. B, 25th Engrs., A. E. F., France.

**Allen, Raymond C.** Capt., Quartermaster Corps, U. S. A.

**Allen, Walter Henry.** Maj., Engineers, U. S. A.

**Allen, Walter Hinds.** Commander, Civil Engineer Corps, U. S. N.

**Allison, William F.** Maj., Engineers, U. S. A., A. E. F., France.

**Altman, Frank S.** Capt., Engineers, U. S. A., 23d Engrs., A. E. F., France.

**Altstaetter, F. W.** Col., Engineers, U. S. A.

**Alvey, James P., Jr.** 1st Lieut., Quartermaster Corps, U. S. A., Care, Section Engr., Base Section 4, A. P. O. 760, A. E. F., France.

**Anders, Frank L.** Capt., Quartermaster Corps, U. S. A.

**Anderson, C. L. B.** Lieut., Civil Engineer Corps, U. S. N.

**Anderson, J. E.** Maj., 212th Field Co., Royal Engrs., B. E. F., France.

**Anderson, W. P.** Capt., Engineers, U. S. A., A. E. F., France.

**Anderson, W. S.** Cadet, School of Military Aeronautics, U. S. A.

**Andrew, Clarence R.** Capt., Engineers, U. S. A., 32d Engrs., A. P. O. 705, A. E. F., France.

**Andrews, J. H. M.** Lt.-Col., Ordnance, U. S. A.

**Angas, Robert M.** 1st Lieut., U. S. A., 106th Engrs.

**Applegarth, Gault.** Capt., Engineers, U. S. A., 23d Engrs., A. E. F., France.

**Arakawa, Futoshi.** 2d Lieut., Co. K, 1st Hawaiian Inf., U. S. A., Schofield Barracks, Hawaii.

**Ardery, Edward Dahl.** Col., Engineers, U. S. A.

**Armitage, George W.** Maj., Quartermaster Corps, U. S. A.

**Armstrong, Charles Johnstone.** Brig.-Gen.; Chf. Engr., H. Q., Canadian Army Corps, B. E. F., France.

**Armstrong, Merwin.** Capt., Engineers, U. S. A., Co. D, 105th Engrs., A. E. F., France.

**Armstrong, Roger W.** Capt., Quartermaster Corps, U. S. A.

**Arn, William G.** Maj., Engineers, U. S. A., 2d Bn., 13th Engrs. (Ry.), A. E. F., France.

**Arnold, Bion J.** Lt.-Col., Air Service, U. S. A.

**Ashkins, Nathan Thomas.** 1st Lieut., Engineers, U. S. A., Lines of Communication, Eng. Headquarters, A. E. F., France.

**Ashley, Carl.** Capt., Engineers, U. S. A., U. S. M. P. O. 702, A. E. F., France.

**Ashmead, P. H.** Maj., Engineers, U. S. A.

**Asplundh, E. T.** Capt., Engineers, U. S. A., 103d Engrs., A. P. O. 744, A. E. F., France.

**Asserson, Henry Raymond.** Maj., Engineers, U. S. A., C. E. L. O. C., A. E. F., France.

**Atterbury, W. W.** Brig.-Gen.; Director-General of Transportation, A. E. F., France.

**Atwood, William C.** Lt.-Col., Engineers, U. S. A.; Am. Member, Transportation Committee for Eastern Europe for the Inter-Allied Supreme Economic Council, 10 rue Faquet, Paris, France.

**Ayres, John Henry.** Capt., Engineers, U. S. A., Co. D, 42d Engrs.

**Ayres, Quincy C.** 2d Lieut., Engineers, U. S. A. (*Unattached*), A. E. F., France.

**Bailey, Lewis P.** Capt., Engineers, U. S. A., Co. A, 304th Engrs.

**Bakenhus, R. E.** Commander, Civil Engineer Corps, U. S. N.

**Baker, George L.** Capt., Inf., U. S. A., 23d Co., Military Police, 6th Bn., 153d Depot Brigade, Camp Dix, N. J.

**Baker, H. S.** Col., Engineers, U. S. A., 111th Engrs., 36th Div., A. E. F., France.

**Baker, Shirley.** Capt., Engineers, U. S. A., Co. B, 23d Engrs.

**Balch, William H.** Maj., Engineers, U. S. A., A. P. O. 717, A. E. F., France.

**Barber, Charles W.** Private, 38th Engrs.

**Barber, Justin F.** Sergeant, Co. M, 23d Engrs., A. E. F., France.

**Barber, Norman N.** Capt., Engineers, U. S. A., 16th Engrs., A. E. F., France.

**Barclay, A. J.** 1st Lieut., Engineers, U. S. A.

**Barnard, Archer F.** 1st Lieut., Engineers, U. S. A.

**Barney, Samuel E.** Maj., Engineers, U. S. A. (*Unassigned*).

**Barry, E. J.** Maj., Engineers, U. S. A.

**Bartholomew, B. W.** 1st Lieut., Engineers, U. S. A., 301st Engrs., A. E. F., France.

**Bascom, George R.** Maj., Sanitary Corps, U. S. A.

**Bass, Fred T.** Capt., Engineers, U. S. A., Headquarters, 1st Bn., 32d Engrs., A. E. F., France.

**Bassett, Herbert H.** Maj., Engineers, U. S. A.

**Battie, H. S.** 1st Lieut., Engineers, U. S. A.

**Baver, Walter S.** Lieut., Sanitary Corps, U. S. A.

**Baxter, O. G.** Capt., Engineers, U. S. A., Co. C, 601st Engrs.

**Bayliss, Paul.** 2d Lieut., Engineers, U. S. A., 8th Engrs. (Mounted).

**Beach, Lansing H.** Col., Engineers, U. S. A.

**Beale, Allan S.** Lieut., U. S. Air Service (Aeronautics).

**Beall, Pendleton.** 2d Lieut., Infantry, O. R. C., U. S. A.

**Beam, Carl Eugene.** 2d Lieut., Engineers, U. S. A., 541st Engrs., A. E. F., France.

**Bean, Paul Jones.** Civ. Engr., U. S. N.

**Beard, Robert S.** Capt., Quartermaster Corps, U. S. A.; Engr. of Water and Sewers, Utilities Branch, Camp Lee, Va.

**Beebe, James W.** Capt., Engineers, U. S. A.

**Beeman, Thomas R.** Capt., Engineers, U. S. A., Care, Chf. Engr., A. E. F., France.

**Begg, R. B. H.** Capt., Engineers, U. S. A., A. E. F., France.

**Behrman, I. E.** Capt., Engineers, U. S. A., Care, C. E. O., A. E. F., France.

**Bell, George Edward.** Lieut., Canadian Engrs., Care, Dominion Bridge Co., Ltd., Montreal, Que., Canada.

**Bell, Harry W.** Capt., Engineers, U. S. A., 5th Bn., 22d Engrs., A. E. F., France.

**Bellinger, L. F.** Commander, Civil Engineer Corps, U. S. N.

**Benham, Claude Gilbert.** Capt., Coast Artillery, U. S. A.

**Benham, W. L.** Maj., Quartermaster Corps, U. S. A.

**Bennett, John W. F.** Maj., Quartermaster Corps, U. S. A., Constr. Div.

**Bennison, Ernest William.** 1st Lieut., Engineers, U. S. A., 23d Engrs.

**Benson, Orville.** Maj., Engineers, U. S. A., A. E. F., France.

**Berdeau, Ray W.** Capt., Engineers, U. S. A.; Engr. Officer, 220th Engrs.

**Bessey, Roy F.** Lieut., U. S. A., Co. B, 57th Engrs., A. E. F., France.

**Bickel, George R.** Chf. Machinist's Mate, U. S. N. R. F.

**Biddle, John.** Maj.-Gen., U. S. A.

**Billings, Fred M.** Capt., Engineers, U. S. A.

**Binckley, George Sydney.** Maj., Engineers, U. S. A., 112th Engrs., A. E. F., France.

**Birdseye, Claude H.** Maj., Engineers, U. S. A., Office, Chf. of Artillery, A. P. O. 706, A. E. F., France.

**Bishop, Roy P.** 2d Lieut., Engineers, U. S. A.; Personnel Adjt., 35th Engrs., A. E. F., La Rochelle, France.

**Bissell, C. T.** Capt., Quartermaster Corps, U. S. A.

**Bither, T. A.** 2d Lieut., Signal Corps, Aviation Section, U. S. A.

**Bixby, William H.** Brig.-Gen., U. S. A. (*Retired*).

**Black, Dudley F.** Capt., Engineers, U. S. A., Co. C, 513th Engrs., A. E. F., France.

**Black, E. B.** Maj., A. S. (P.), U. S. A.

**Black, G. G.** Capt., Engineers, U. S. A.; Acting Adjt., 314th Engrs.

**Black, James B.** Capt., Engineers, U. S. A., Office, D. M. E. and E. S., A. P. O. 717, A. E. F., France.

**Black, Ralph P.** 1st Lieut., Engineers, U. S. A., 32d Engrs.

**Black, Roger Derby.** Col., Gen. Staff, U. S. A.

**Black, William M.** Maj.-Gen., U. S. A.; Chf. of Engrs., U. S. A.

**Blackman, J. W. B.** Lieut., Canadian Ry. Troops, C. E. F., France.

**Blair, Alexander.** 2d Lieut., Royal Engrs., B. E. F., France.

**Blair, McCrea Parker.** Capt., No. 1 Depot Bn., Manitoba Regt., Winnipeg, Man., Canada.

**Blanchard, Murray.** Maj., Engineers, U. S. A., 520th Engrs.

**Blauvelt, Louis D.** Maj., Quartermaster Corps, U. S. A.

**Blucher, Conrad M. von.** 1st Lieut., Engineers, U. S. A.

**Boesch, Clarence E.** Capt., U. S. A., Co. B, 105th Engrs.

**Boggs, F. C.** Col., U. S. A.

**Boland, Charles J.** 1st Lieut., Signal Corps, U. S. A., 492d Constr. Div., A. E. F., France.

**Bolger, Edwin Gibson.** Barron Field, Everman, Tex.

**Bolin, Harry W.** Sergeant, Co. E, 23d Engrs.

**Bolton, Frank L.** Capt., Engineers, U. S. A.

**Bond, P. S.** Col., U. S. A., 107th Engrs.; Div. Engr., 32d Div., Army Engr. School, U. S. P. O. 714, A. E. F., France.

**Boorman, Kitchell M.** Lieut., U. S. A., Office, Chf. Engr., 2d Army, A. P. O. 784, A. E. F., France.

**Booth, Raymond.** 1st Lieut., Engineers, U. S. A., 54th Engrs.

**Borchers, Perry E.** Capt., Engineers, U. S. A.

**Borden, Guy.** Lieut., Engineers, U. S. A.

**Boschke, Guy.** Maj., Engineers, U. S. A., M. P. O. 705, A. E. F., France.

**Bott, C. N.** Capt., Engineers, U. S. A., 27th Engr. Service Co. (Forestry), A. E. F., France.

**Boult, Charles N.** 2d Lieut., 28th Reinforcements, New Zealand Engrs., N. Z. E. F., Care, P. O., Wellington, New Zealand.

**Bowe, Thomas F.** Capt., Quartermaster Corps, U. S. A., Constr. Div.

**Bowen, Charles K.** Capt., Engineers, U. S. A.

**Bowie, William.** Maj., Engineers, U. S. A.

**Bowne, Sidney B.** 2d Lieut., U. S. Public Health Service.

**Boyd, George R.** Capt., Engineers, U. S. A., A. E. F., France.

**Boyden, Harry C.** Maj., Engineers, U. S. A.

**Brace, James H.** Maj., U. S. A., 22d Engrs., A. E. F., France.

**Bragg, Kendal B.** Lieut., Civil Engineer Corps, U. S. N.

**Braly, Raymond F.** 1st Lieut., Engineers, U. S. A.

**Braunworth, Percy L.** Capt., Engineers, U. S. A., Care, Director-General of Transportation, Army P. O. 705, A. E. F., France.

**Breck, Charles R., Jr.** Capt., Engineers, U. S. A., 31st Engrs., A P. O. 718, A. E. F., France.

**Bres, Edward Sedley.** Capt., Engineers, U. S. A.; Adjt., 114th Engrs., 1st Army Corps, A. E. F., France.

**Brewster, Henry B.** Capt., Engineers, U. S. A., and Adjt., 66th Engrs., A. E. F., France.

**Breymann, John B., Jr.** 2d Lieut., Coast Artillery, U. S. A., 22d Co.

**Briggs, Robert W.** 2d Lieut., Signal Corps, Aviation Section, U. S. A., 73d Aero Constr. Squadron.

**Bright, Graham B.** Capt., Engineers, U. S. A., and Regimental Adjt., 305th Engrs. (Pioneers).

**Brinkley, Milo H.** Capt., Engineers, U. S. A.

**Bronson, Howard F.** Capt., Sanitary Corps, U. S. A.

**Brook, A. E.** Capt., Royal Engrs., B. E. F., France.

**Brooking, J. H.** Capt., Engineers, U. S. A., Co. B, 12th Engrs. (Ry.), A. E. F., France.

**Brooks, Josiah R.** 1st Lieut., Engineers, U. S. A.

**Brower, I. C.** Maj., Quartermaster Corps, U. S. A., Constr. Div.

**Brown, Charles E.** Capt., Engineers, U. S. A.

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**Fox, Robert Myron.** Capt., Engineers, U. S. A.

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**Johnson, Halbert T.** Sergeant, 472d Engrs.

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**Sutton, Frank.** Maj., Engineers, U. S. A., 29th Engrs.

**Swaren, J. W.** Maj., Engineers, U. S. A.,

**Swartz, Leon.** 2d Lieut., U. S. A., Co. A, 15th Engrs., A. E. F., France.

**Sweeney, Harry C.** Capt., Quartermaster Corps, U. S. A.

**Sweetser, C. H.** Capt., Engineers, U. S. A., 116th Engrs., A. E. F., France.

**Sweetser, E. O.** Capt., Engineers, U. S. A. (*Unattached*), A. E. F., France.

**Symonds, G. R. B.** Capt., Engineers, U. S. A., 605th Engrs., A. P. O. 931, A. E. F., France.

**Tainter, F. S.** Maj., Engineers, U. S. A.

**Talbot, K. H.** Capt., Quartermaster Corps, U. S. A.

**Tandrow, Walter S.** 1st Lieut., Engineers, U. S. A.

**Tate, R. L.** Capt., Engineers, U. S. A.; Adjt., 1st Bn., 303d Engrs., A. E. F., France.

**Taylor, Arthur.** Capt., Engineers, U. S. A.

**Taylor, Edwin A.** Maj., Engineers, U. S. A., 508th Engrs., A. E. F., France.

**Taylor, Harry.** Brig.-Gen., U. S. A.

**Taylor, Henry.** Maj., Engineers, U. S. A., 58th Inf. Brigade, 29th Div., A. E. F., France.

**Taylor, Hugh M.** Maj., U. S. A., Care, D. G. T., A. P. O. 762, A. E. F., France.

**Taylor, Nelson.** Lieut., U. S. N., U. S. S. *Bridgeport.*

**Taylor, P. M.** 2d Lieut., R. E., 237th Field Co., B. E. F., Italy.

**Taylor, Seneca V.** Capt., Coast Artillery, U. S. A.

**Taylor, William T.** Staff Capt., Air Ministry, R. A. F., England.

**Taylor, Wyllys H.** Capt., Engineers, U. S. A., 306th Engrs.

**Ten Hagen, Henry.** 2d Lieut., Engineers, U. S. A., 303d Engrs.

**Tenney, Willis R.** Capt., Engineers, U. S. A., A. E. F., France.

**Thomas, Charles D.** Capt., Engineers, U. S. A., 6th Engrs. (Forestry), A. P. O. 909, A. E. F., France.

**Thomas, W. E.** Capt., Constr. Div., Quartermaster Corps, U. S. A.

**Thomas, William Michael.** Capt., Engineers, U. S. A.

**Thomsen, S. L.** Capt., Engineers, U. S. A., Co. A, 57th Engrs., A. E. F., France.

**Thomson, F. M.** Capt., U. S. A., 39th Engrs., A. E. F., France.

**Thornton, L. Earle.** Lieut., Civil Engineer Corps, U. S. N. R. F., U. S. N. S., Le Croisic, France.

**Throop, George H.** Maj., Engineers, U. S. A., 24th Engrs.

**Thurber, Clinton D.** Commander, Civil Engineer Corps, U. S. N.

**Thurston, Eugene T.** Capt., Engineers, U. S. A., 2d Section, Gen. Staff, G. H. Q., A. E. F., France.

**Tilden, Charles Joseph.** Capt., Engineers, U. S. A. (*Unassigned*).

**Tinkham, Ralph R.** Capt., Engineers, U. S. A., 420th Engrs.

**Tinsley, R. B.** Capt., Engineers, U. S. A., Co. C, 605th Engrs., A. E. F., France.

**Tirrell, Charles Edwards.** Lieut., U. S. A., Headquarters, U. S. Air Service, Paris, France.

**Todd, Frank Herbert.** Maj., Quartermaster Corps, U. S. A.

**Todd, Oliver J.** Capt., Engineers, U. S. A., A. P. O. No. 780, A. E. F., France.

**Tolles, F. C.** Capt., Engineers, U. S. A., 112th Engrs, A. E. F., France.

**Tomlinson, Alfred Thomas.** Maj., Canadian Engrs.; Insp., Small Arms Ammunition, Dominion Arsenal, Lindsay, Ont., Canada.

**Tompkins, Robert Harry.** 1st Lieut., U. S. A., 111th Engrs., A. E. F., France.

**Topping, Perry.** Capt., Engineers, U. S. A., 5th Engrs.

**Torrance, William M.** Capt., Engineers, U. S. A.

**Townsend, C. McD.** Col., Engineers, U. S. A., 12th Engrs. (Ry.), A. E. F., France.

**Toyne, John Wilson.** Capt., Quartermaster Corps, U. S. A.

**Tracy, Herbert Herman.** 1st Lieut., Engineers, U. S. A., Engr. Wagon Co. 4, 23d Engrs., A. E. F., France.

**Travers-Ewell, Andrew.** Capt., Care, Gibbs & Co., Antofagasta, Chile.

**Treser, Albert Paul.** Co. A, 605th Engrs., A. E. F., France.

**Trimpi, Allan Littell.** 1st Lieut., U. S. A., 104th Engrs.

**Trout, Alexander Linn.** Capt., Engineers, U. S. A. (*Unassigned*), D. M. E. and E. S., A. E. F., Tours, France.

**True, Albert O.** Capt., Engineers, U. S. A.

**Trueblood, P. McG.** Lieut., U. S. N. R. F.

**Tucker, H. F.** Ensign, U. S. N. R. F.; Navigator, U. S. S. *Aroostook.*

**Turley, Jay.** Capt., Engineers, U. S. A.

**Turner, Daniel Norman.** 2d Lieut., Engineers, U. S. A., 304th Engrs.

**Turner, Nathaniel Parker.** Capt., U. S. A., Co. B, 111th Engrs., A. E. F., France.

**Tuska, Gustave R.** Maj., Engineers, U. S. A.

**Tyler, Richard G.** Capt., Quartermaster Corps, U. S. A.

**Tyson, William C.** Capt., Engineers, U. S. A., Co. No. 2, Camp Custer Replacement Draft, A. E. F., France.

**Uhler, W. D.** Lt.-Col., Quartermaster Corps, U. S. A.

**Van Amburgh, Thomas A.** 1st Lieut., Quartermaster Corps, U. S. A.

**Van Buren, Maurice Pelham.** Capt., Engineers, U. S. A., 602d Engrs.

**Vandemoer, John Jay.** Capt., U. S. A., 467th Engrs., A. E. F., France.

**Vandemoer, N. C.** Capt., Engineers, U. S. A.

**Vanderhoof, Arnold H.** Lieut., U. S. N. (*Retired*), Radio Div., Bureau of Steam Eng.

**Vandervoort, B. F.** Capt., Engineers, U. S. A.

**Vandevanter, Elliott.** Capt., Engineers, U. S. A., Co. D, 503d Engrs., A. E. F., France.

**Van Ness, R. A.** Capt., Engineers, U. S. A.; Regimental Adjt., 604th Engrs., A. E. F., France.

**Van Ornum, Samuel Judson.** Capt., Engineers, U. S. A.

**Van Suetendael, Achille O.** Capt., Engineers, U. S. A.

**Van Zile, Harry Lee.** Maj., Engineers, U. S. A., Office, D. of C. and F., S. O. S., A. E. F., France.

**Vaughan, Henry F.** Capt., Sanitary Corps, U. S. A.

**Verrill, George E.** Maj., Engineers, U. S. A.

**Vincent, J. I.** Capt., Ordnance, U. S. A.

**Vincent, W. H.** 1st Lieut., Engineers, U. S. A.

**Vogdes, Joseph J.** Capt., Railroad Transportation Corps, U. S. A., Care, D. G. T., A. E. F., France.

**Volk, Wendell Douglas.** Capt., Engineers, U. S. A.

**von Deesten, A. P.** Maj., Engineers, U. S. A.

**Wade, George W.** 1st Lieut., Co. D, 2d Bn., 117th Engrs., 42d Div., A. E. F., France.

**Wadsworth, Henry H.** Maj., Engineers, U. S. A.

**Wagner, Allan J.** Capt., Engineers, U. S. A.

**Wagner, John, Jr.** 1st Lieut., Cavalry, U. S. A., First Corps School, Army P. O. No. 703, A. E. F., France.

**Waite, Clement F.** 1st Lieut., Engineers, U. S. A.

**Waite, H. M.** Lt.-Col., Railroad Transportation Corps, U. S. A., Care, Railroad Transportation Corps, A. E. F., France.

**Waldron, Albert E.** Col., U. S. A., General Headquarters, American Army, A. E. F., Chaumont Haut Marne, France.

**Walker, Edward G.** Capt., Royal Air Service; 78 Cheyne Court, Chelsea, London, S. W. 3, England.

**Walker, Harry Bruce.** Capt., Engineers, U. S. A.

**Walker, Meriwether Lewis.** Col., Engineers, U. S. A., G. H. Q., A. E. F., France.

**Walker, W. Kemp.** Capt., Engineers, U. S. A.

**Wallace, David A.** Capt., Engineers, U. S. A., Headquarters, Director General of Transportation, A. P. O. 717, A. E. F., France.

**Wallace, Harold U.** Maj., Engineers, U. S. A.

**Waller, Alexander C.** 1st Lieut., Engineers, U. S. A., 22d Engrs., A. E. F., France.

**Waller, Percy.** Capt., Engineers, U. S. A.

**Walter, Frank E.** 1st Lieut., Co. B, 55th Engrs., A. E. F., France.

**Walton, H. B.** Capt., Engineers, U. S. A., 312th Engrs.

**Wanzer, James O.** 1st Lieut., U. S. A., 47th Engrs., A. E. F., France.

**Ward, George S.** 2d Lieut., Engineers, U. S. A., Co. A, 117th Engrs., A. E. F., France.

**Ward, Lyman Wise.** Capt., Coast Artillery, U. S. A.; Adjt., 1st Bn., 63d Artillery.

**Wardwell, Ralph W.** Capt., Engineers, U. S. A.

**Ware, Howard T.** 2d Lieut., Quartermaster Corps, U. S. A., Bakery Co. No. 317.

**Ware, John.** Capt., U. S. A., 101st Engrs., A. E. F., France.

**Ware, Norton.** Maj., Engineers, U. S. A.

**Warfield, Ralph M.** Lt.-Commander, Civil Engineer Corps, U. S. N.

**Waring, C. T.** Maj., Signal Corps, U. S. A.

**Warner, Elwin S.** Capt., Engineers, U. S. A.; Adjt., 1st Bn., 301st Engrs., Army of Occupation, Brohl-am-Rhine, Germany.

**Warnock, W. H.** Capt., Quartermaster Corps, U. S. A.

**Warren, Horace P.** Maj., U. S. A., 55th Engrs., A. E. F., France.

**Warren, James G.** Col., Engineers, U. S. A.

**Warren, Minton M.** Capt., Engineers, U. S. A.; Topographical Officer, 101st Engrs., 26th Div., A. E. F., France.

**Warren, Philip R.** Maj., Royal Engrs., 3 P. C., H. Q., B. A. P. O. 2, B. E. F., France.

**Waterman, Earle L.** 1st Lieut., Sanitary Corps, U. S. A.

**Watkins, Guy A.** Capt., Engineers, U. S. A.

**Watson, D. M.** Lieut., R. A. S. C., 123d Auxiliary Petrol Coy., B. E. F., France.

**Watson, George L.** Lt.-Col., Engineers, U. S. A., General Staff (A. C. of S. G. 2), Third Army Corps, Coblenz, Germany.

**Watson, Loyall F.** 1st Lieut., U. S. A., 403d Engrs.

**Watson, Winslow B.** 1st Lieut., U. S. A., 106th Inf.

**Waugh, William H.** Maj., Engineers, U. S. A.

**Way, W. F.** 1st Lieut., Engineers, U. S. A., 130th Engrs., A. E. F., France.

**Weaver, C. J.** 1st Lieut., Engineers, U. S. A.

**Weaver, Earll Chase.** Civ. Engr., U. S. N. R. F.

**Weaver, Frank L.** Capt., Engineers, U. S. A., 305th Engrs.

**Webb, Claude A.** 2d Lieut., Field Artillery, U. S. A., 121st F. A., A. E. F., France.

**Webb, De Witt Clinton.** Commander, Civil Engineer Corps, U. S. N.

**Webb, George H.** Col., Engineers, U. S. A.; Section Engr., Int. Sec., East, A. P. O. 708, A. E. F., France.

**Webb, Walter Loring.** Maj., Engineers, U. S. A., A. E. F., France.

**Weeks, W. C.** Lt.-Col., Engineers, U. S. A., 32d Engrs., A. P. O. 705, A. E. F., France.

**Weidman, William R.** Capt., Engineers, U. S. A., 547th Engrs.

**Welden, Ernest.** Private, Co. A, 43d Engrs., A. E. F., France.

**Welles, Theodore L., Jr.** 1st Lieut., Engineers, U. S. A., 318th Engrs., 6th Div., A. E. F., France.

**Wells, Emery.** 1st Lieut., Engineers, U. S. A., A. P. O. 712, A. E. F., France.

**Welsh, Russell D.** Corporal, Co. F, 115th Engrs., A. E. F., France.

**Wenige, Arthur E.** Maj., Engineers, U. S. A., 317th Engrs.

**Wenzell, Andrew P.** Maj., Engineers, U. S. A., 1st Bn., 16th U. S. Engrs. (Ry.), A. E. F., France.

**West, Edward Hazzard.** Capt., Engineers, U. S. A., 5th Engrs., 7th Div., A. E. F., France.

**West, Robert Kirby.** Capt., Engineers, U. S. A., 3d Aviation Instruction Center, A. P. O. 724, A. E. F., France.

**West, Wade C.** Capt., Engineers, U. S. A.

**Wheeler, Edgar True.** Capt., U. S. A., 125th Engrs.

**Wheeler, Frank I.** 1st Lieut., Air Service (A. P.), U. S. A.

**Wheeler, Robert C.** Capt., Quartermaster Corps, U. S. A.

**Wheelock, De Forest A.** Col., U. S. A.

**Whiteaker, Robert O.** Capt., U. S. A., 132d F. A.

**Whitman, Ezra B.** Maj., Quartermaster Corps, U. S. A.

**Whitman, Ralph.** Lt.-Commander, Civil Engineer Corps, U. S. N.

**Whitney, C. S.** Corporal, Co. F, 25th Engrs., A. P. O. 705, A. E. F., France.

**Whitney, John T.** 2d Lieut., Field Artillery, U. S. A., Motor Transport Office, Base Section No. 5, A. P. O. 716, A. E. F., France.

**Whitney, Ralph Edward.** Capt., Sanitary Corps, U. S. A.

**Whitsit, Lyle A.** Capt., Engineers, U. S. A.

**Whitwell, E.** Capt., General Service Staff, British War Office, Robert Treat Hotel, Newark, N. J.

**Widdicombe, R. A.** Maj., Engineers, U. S. A.

**Wiggin, Thomas H.** Maj., Engineers, U. S. A., A. E. F., France.

**Wiggins, Ralph Raymond.** 1st Lieut., Aviation Section, Signal Corps, U. S. A.

**Wilcox, Ernest Hardwick.** Capt., Engineers, U. S. A., 543d Engrs., A. E. F., France.

**Wild, H. J.** Maj., Engineers, U. S. A.

**Willard, George T.** Private, Co. E, 318th Engrs.

**Willard, N. R.** Capt., Engineers, U. S. A.

**Willcomb, George E.** Capt., Quartermaster Corps, U. S. A.

**Willcox, Henry.** Capt., Quartermaster Corps, U. S. A., Constr. Div.

**Williams, Alan F.** 2d Lieut., Co. B, 18th Engrs. (Ry.), U. S. Army P. O. No. 705, A. E. F., France.

**Williams, George D.** Capt., Engineers, U. S. A., Co. H, 548th Engrs., A. E. F., France.

**Williams, Samuel W.** Maj., Engineers, U. S. A.

**Williamson, Harry.** Capt., Royal Engrs.; O. C. 272d Ry. Constr. Co., R. E., E. E. F., Egypt.

**Williamson, Lee H.** 2d Lieut., Engineers, U. S. A., Co. A, 55th Engrs.

**Williamson, Sydney B.** Lt.-Col., Engineers, U. S. A.

**Williar, Harry D., Jr.** Maj., U. S. A., 1st Engrs., A. E. F., France.

**Willis, Walter John.** Lieut. (EDO).

**Wilson, Edbert C.** Capt., Engineers, U. S. A., A. P. O. 790, A. E. F., France.

**Wilson, Everitt W.** Capt., Engineers, U. S. A., Co. A, 304th Engrs.

**Wilson, Harry P.** Capt., Engineers, U. S. A., 310th Engrs.

**Wilson, Louis A.** Capt., U. S. A., 417th Engrs.

**Wilson, Robert B. M.** Capt., Engineers, U. S. A., 311th Engrs.

**Wilson, William R.** Maj., 23d Field Co., R. E., B. E. F., France.

**Wing, Charles B.** Maj., Engineers, U. S. A., 23d Engrs., A. P. O. 738, A. E. F., France.

**Winn, Walter E.** Lt.-Col., Engineers, U. S. A., 114th Engrs., A. E. F., France.

**Winn, Walter S.** Maj., Engineers, U. S. A.

**Winton, Walter Ferrell.** Lt.-Col., U. S. A.

**Wolff, R. B.** Capt., U. S. A.

**Wondries, Charles H.** 1st Lieut., Engineers, U. S. A., 428th Engrs.

**Wood, B. Russell.** Maj., Engineers, U. S. A., A. P. O. 713, A. E. F., France.

**Wood, Frederic J.** Maj., Engineers, U. S. A.

**Woodard, Wilkie.** Capt., Engineers, U. S. A., Co. H, 35th Engrs., A. P. O. 735, A. E. F., France.

**Woodle, Bernon Tisdale.** Capt., Engineers, U. S. A.

**Woodruff, Charles W.** 1st Lieut., U. S. A., 403d Engrs.

**Woodward, Edwin C.** Capt., U. S. A., 22d Engrs., A. E. F., France.

**Woolworth, W. H.** Maj., Infantry, U. S. A.

**Wooten, William P.** Col., Engineers, U. S. A., Headquarters, 3d Corps, A. E. F., France.

**Wright, Frederick J.** Corporal. Camp Headquarters Co., Camp Dix, N. J.

**Wright, Jesse B.** Capt., Engineers, U. S. A.

**Wright, John Bertram.** Capt., Engineers, U. S. A.

**Wrightson, William D.** Col., Sanitary Corps, U. S. A.

**Yates, Sheldon S.** Field Artillery Officers' Training Camp, Camp Zachary Taylor, Ky.

**Yeo, W. H. W.** Capt., Engineers, U. S. A.

**Yereance, Alex. W.** 1st Lieut., Co. F, 305th Engrs., A. E. F., France.

**Yost, Howard McC.** Maj., Engineers, U. S. A.

**Young, Charles C.** 1st Lieut., Engineers, U. S. A.

**Young, Frederick C.** Capt., Engineers, U. S. A.; Adjt., 114th Engrs., A. E. F., France.

**Young, George S.** Capt., Engineers, U. S. A., 29th Engrs.; Executive Officer, G-2-C, 2d Army, A. E. F., France.

**Zinn, George A.** Col., Engineers, U. S. A.

## MEMBERSHIP

(From February 7th to March 6th, 1919)

### ADDITIONS

#### MEMBERS

| | | Date of Membership |
|---|---|---|
| Ayer, John. Executive Engr., Fay, Spofford & Thorndike, 308 Boylston St., Boston (Res., 11 Boylston Terrace, West Medford), Mass. | Assoc. M.<br>M. | Oct. 7, 1914<br>Jan. 14, 1919 |
| Meyer, Charles Louis. Pres. and Gen. Mgr., Concrete Eng. Co., 612 Omaha National Bank Bldg., Omaha, Nebr. | Assoc. M.<br>M. | Mar. 13, 1917<br>Jan. 14, 1919 |
| Vogel, John Leonard. Designing Bridge Engr., Board of Public Utility Commrs., State of New Jersey, Newark (Res., 163 Clinton Ave., Jersey City), N. J. | Jun.<br>Assoc. M.<br>M. | Nov. 5, 1907<br>May 6, 1914<br>Jan. 14, 1919 |
| Woody, Norman Cooper. Chf. Pilot Engr., St. L.-S. F. Ry., 623 Frisco Bldg., St. Louis, Mo. | Assoc. M.<br>M. | Jan. 17, 1916<br>Jan. 14, 1919 |
| Woolley, William John Moore. City Engr., Town Hall, Caulfield, Victoria, Australia | | Nov. 26, 1918 |

#### ASSOCIATE MEMBERS

| | |
|---|---|
| Beilharz, William Earnest. Chf. Engr., Dallas Office, Truscon Steel Co., 738 Wilson Bldg., Dallas, Tex. | Jan. 13, 1919 |
| Bird, Byron. 1602 Second Ave., North, Fort Dodge, Iowa. | Nov. 26, 1918 |
| Crosson, William Henry. 1st Lieut., Engrs., U. S. A., Headquarters, 2d Bn., 20th Engrs., U. S. M. P. O. 717, Am. Exp. Forces, France; Address, 296 Chelsea Ave., Long Branch, N. J. | Sept. 10, 1918 |
| Davis, Norman Engle. Res. Engr., Hudson Val. Ry., 16 Davis St., Glens Falls, N. Y. | Sept. 10, 1918 |
| Farrington, Arthur E. Chf. of Constr., State Highway Dept., Wellsboro, Pa. | Jan. 13, 1919 |
| Gaylord, Ralph Welles. Care, Hawaiian Dredging Co., Honolulu, Hawaii. | Jan. 13, 1919 |
| Hill, Norman Haden. 1351 Monroe St., N. W., Washington, D. C. | Jan. 13, 1919 |
| Lowell, John Wesley, Jr. Div. Engr., Promotion Bureau, Universal Portland Cement Co., 524 Frick Bldg., Pittsburgh, Pa. | Jan. 13, 1919 |
| Moore, Walter, Jr. Dist. Engr., Los Angeles County Road Dept., Maintenance Div., 1104 Hall of Records, Los Angeles, Cal. | Jan. 13, 1919 |
| Nickerson, Edward Douglas. Civ. Engr., State Dept. of Eng., 1220 Eighteenth St., Sacramento, Cal. | Jan. 13, 1919 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| ORBECK, MARTIN J. Capt., Engrs., U. S. A., Headquarters, 528th Engrs. Service Bn., A. P. O. 784, Am. Exp. Forces, France. (Res., 3925 Oakland Ave., Minneapolis, Minn.) | Jun. | June 24, 1914 |
| | Assoc. M. | Jan. 13, 1919 |
| PEMBERTON, JAMES REX. Supt. of Sewer Constr., City of Flint, 729 Evergreen St., Flint, Mich | Jun. | May 2, 1911 |
| | Assoc. M. | Jan. 13, 1919 |
| RIBEIRO, GEORGE. Head of Drawing Office, The Leopoldina Ry., Ltd., Rua da Gloria 36, Rio de Janeiro, Brazil | | Nov. 26, 1918 |
| RUSSELL, ALEXANDER ALLEN MACVICAR. Inspecting Engr., Concrete Ship Dept., Emergency Fleet Corporation, 2712 Stuart St., Berkeley, Cal | Jun. | May 5, 1908 |
| | Assoc. | Feb. 4, 1913 |
| | Assoc. M. | Jan. 14, 1919 |
| SALE, CLARENCE STANLEY. Asst. to the Pres., The Railway Car Mfrs. Assoc., 61 Broadway, Room 2216, New York City | | Jan. 13, 1919 |
| SIVASLIAN, HYRAND ARAKEL. Eng. Dept., Goodyear Tire & Rubber Co., Akron, Ohio | | Jan. 13, 1919 |
| STILES, THOMAS ALGEO. Supt. of Constr., Cerro de Pasco Copper Corporation, Oroya, Peru | | Nov. 26, 1918 |
| STOUT, BENJAMIN ELLIS WARREN. Contr. Engr., The Midland Bridge Co., 2613 East 29th St., Kansas City, Mo | | Jan. 13, 1919 |
| WENTZ, FOSTER PRATT. 408 Wells Fargo Bldg., Portland, Ore | | Jan. 13, 1919 |

JUNIORS

| | | |
|---|---|---|
| LING, HUNG HSUN. Care, Chinese Ry. Assoc., West Chang An St., Peking, China | | Oct. 8, 1918 |
| PIODA, FERNANDO CHARLES. 337 Foul Bay Rd., Victoria, B. C., Canada | | Jan. 13, 1919 |
| THOMAS, MARVIN WATTERSON. Care, Asst. Engr., Tex. & Pac. Ry., Fort Worth, Tex | | Oct. 8, 1918 |
| WATT, ROBERT FARQUHAR. Structural Draftsman, Niagara River Bridge, M. C. R. R., Detroit, Mich | | Sept. 10, 1918 |

## CHANGES OF ADDRESS

### MEMBERS

ANDREWS, DAVID HERBERT. Pres., The Boston Bridge Works, Inc., 47 Winter St., Boston (Res., 19 Alden St., Newton Center), Mass.

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BILLIN, CHARLES EMERY. Pelham Manor, N. Y.

BOGGS, FRANK CRANSTOUN. Col., U. S. A., 1868 Columbia Rd., Washington, D. C.

BROOKS, WALTER FREEMAN. Senior Highway Engr., Dept. of Public Roads, Federal Bldg., South Chicago, Ill.

BROWN, STEPHEN PEARSON. Vice-Pres. and Gen. Mgr., Ford, Bacon & Davis Corporation, Russell, Va.

BURT, HENRY JACKSON. Maj., Q. M. C., U. S. A., Care, Constr. Div., U. S. A., 7th and B Sts., S. W., Washington, D. C.

BYAM, LE ROY HENRY. Maj., Engrs., U. S. A., 128th Engrs., Gen. Constr. Bn., Am. Exp. Forces, France; Address, 51 Edgecliff Terrace, Yonkers, N. Y.

CAMERON, JOHN BOBBS. Box 754, Portsmouth, Va.

CARROLL, CHARLES JOSEPH. Chinese Govt. Rys., Chf. Engr., Szechuen-Hankow Line, I-Kwei Section; Acting Chf. Engr., Szechuen-Hankow Line, Han-I Section, Hankow, China.

CARTER, WILLIAM J. Cons. Engr., 723 Illuminating Bldg., Cleveland, Ohio.

CLAFLIN, WILLIAM BEMENT. New Canaan, Conn.

CLARK, FREDERICK HOWE. Supt., Board of Public Works, Town of Framingham, Framingham, Mass.

CLARK, GEORGE HALLETT. (*Director.*) Engr., Holbrook, Cabot & Rollins Corporation, 52 Vanderbilt Ave., Room 1410, New York City.

CLARKE, ERNEST WILDER. Superv. Engr., Constr. Div., War Dept., Room 1713, Lexington Bldg., Baltimore, Md.

CLINTON, DELMAR SMITH. Maj., Engrs., U. S. A., Constr. Div., 29-31 Salazar, Manila, Philippine Islands.

COCHRANE, VICTOR HUGO. Maj., Q. M. C., U. S. A., Care, Ordnance Claim Board, Gillespie Plant Explosion, Raritan Bldg., Perth Amboy, N. J.

COLLINS, CHARLES DICKEY. Res. Engr., U. S. Shipping Board, Emergency Fleet Corporation, Portsmouth, N. H.

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GALLAGHER, LEONARD BRUCE. Capt., Engrs., U. S. A., 301st Engrs., Am. Exp. Forces, France.

HALL, LESLIE STANDISH. Asst. Engr., Duryea, Haehl & Gilman, 1314 Humboldt Bank Bldg., San Francisco (Res., 5448 Boyd Ave., Oakland), Cal.

HAYS, JAMES BUCHANAN. Empire Bldg., Boise, Idaho.

KNOST, WILLIAM ARNOLD. 1st Lieut., C. A., U. S. A., Co. C, 55th Am. Train, C. A. C., A. P. O. No. 733, Am. Exp. Forces, France.

LEACH, HARRY RAYMOND. Sergeant, 1st Class, Sig. C., U. S. A., Jefferson Barracks, Mo.; Address, 826 Hoyt St., Saginaw, Mich.

MATTHEWS, WARREN SHEPARD. Care, Occidental Forwarding Co., 818 Merchants Exchange Bldg., San Francisco, Cal.

PERRY, ARTHUR FRANKLIN, JR. 2d Lieut., C. A. C., U. S. A., Florida National Bank, Jacksonville, Fla.

ROGERS, LESTER CUSHING. 245 Engineers Bldg., Cleveland, Ohio.

SELL, WILLIAM OSBORNE. 1418 Jefferson Bldg., Birmingham, Ala.

STRACHAN, JOSEPH JOSLIN. Lieut., C. E. C., U. S. N., U. S. Navy Yard, Boston, Mass.

STUPP, JOHN GEORGE. 4053 De Tonty St., St. Louis, Mo.

JUNIORS (*Continued*)

TODD, CARLOS NICOLAS. Engr., Kelvin Eng. Co., O'Reilly No. 7, Havana, Cuba.

WHITNEY, JOHN THAD. 2d Lieut., F. A., U. S. A., Motor Transport Office, Base Section No. 5, A. P. O. 716, Am. Exp. Forces, France.

## REINSTATEMENTS

| ASSOCIATE MEMBERS | Date of Reinstatement. |
|---|---|
| SAWYER, DONALD HUBBARD | Jan. 13, 1919 |
| SAWYER, GEORGE LOYAL | Jan. 13, 1919 |

## DEATHS

BAKER, HOLLAND WILLIAMS. Elected Member, May 7th, 1890; died February 18th, 1919.

DOUGAN, WILLIAM THOMAS. Elected Member, October 2d, 1907; died February 3d, 1919.

HORN, FRANK CHURCHILL. Elected Member, September 1st, 1903; died February 16th, 1919.

HUNT, RUFUS CAMERON. Elected Member, October 5th, 1904; died February 18th, 1919.

KNOWLES, CHARLES H. Elected Associate Member, September 2d, 1914; died February 20th, 1919.

MILLIGAN, ROBERT EDGAR. Elected Member, March 4th, 1914; died February 25th, 1919.

OSTRUP, JOHN CHRISTIAN. Elected Associate Member, March 4th, 1896; Member, March 1st, 1899; died February 28th, 1919.

SCHILLING, ALEXANDER CHARLES. Elected Associate Member, June 18th, 1918; died February 4th, 1919.

SLIFER, HIRAM JOSEPH. Elected Member, June 5th, 1907; died February 3d, 1919.

TOMS, JAY WILLIAM. Elected Junior, November 30th, 1909; died December 20th, 1918.

**Total Membership of the Society, March 6th, 1919, 8 966.**

## MONTHLY LIST OF RECENT ENGINEERING ARTICLES OF INTEREST

(February 1st to March 1st, 1919)

NOTE.—*This list is published for the purpose of placing before the members of this Society, the titles of current engineering articles, which can be referred to in any available engineering library, or can be procured by addressing the publication directly, the address and price being given wherever possible.*

### LIST OF PUBLICATIONS

*In the subjoined list of articles, references are given by the number prefixed to each journal in this list:*

(2) *Journal,* Engrs. Club of Phila., Philadelphia, Pa.
(3) *Journal,* Franklin Inst., Philadelphia, Pa., 50c.
(4) *Journal,* Western Soc. of Engrs., Chicago, Ill., 50c.
(5) *Journal,* Eng. Inst. of Canada, Montreal, Que., Canada.
(6) *Journal,* Am. Inst. of Archts., Washington, D. C., 50c.
(8) *Stevens Indicator,* Hoboken, N. J., 50c.
(9) *Industrial Management,* New York City, 25c.
(11) *Engineering* (London), W. H. Wiley, 432 Fourth Ave., New York City, 25c.
(12) *The Engineer* (London), International News Co., New York City, 35c.
(13) *Engineering News-Record,* New York City, 15c.
(15) *Railway Age,* New York City, 15c.
(16) *Engineering and Mining Journal,* New York City, 15c.
(17) *Electric Railway Journal,* New York City, 10c.
(18) *Railway Review,* Chicago, Ill., 15c.
(19) *Scientific American Supplement,* New York City, 10c.
(20) *Iron Age,* New York City, 20c.
(21) *Railway Engineer,* London, England, 1s. 2d.
(22) *Iron and Coal Trades Review,* London, England, 6d.
(24) *American Gas Engineering Journal,* New York City, 10c.
(25) *Railway Mechanical Engineer,* New York City, 20c.
(26) *Electrical Review,* London, England, 4d.
(27) *Electrical World,* New York City, 10c.
(28) *Journal,* New England Water-Works Assoc., Boston, Mass., $1.
(29) *Journal,* Royal Society of Arts, London, England, 6d.
(32) *Mémoires et Compte Rendu des Travaux,* Soc. Ing. Civ. de France, Paris, France.
(33) *Le Génie Civil,* Paris, France, 1 fr.
(36) *Cornell Civil Engineer,* Ithaca, N. Y.
(42) *Proceedings,* Am. Inst. Elec. Engrs., New York City, $1.
(43) *Annales des Ponts et Chaussées,* Paris, France.
(45) *Coal Age,* New York City, 10c.
(46) *Scientific American,* New York City, 15c.
(47) *Mechanical Engineer,* Manchester, England, 3d.
(54) *Transactions,* Am. Soc. C. E., New York City, $12.
(55) *Mechanical Engineering:* Journal, Am. Soc. M. E., New York City, $10.
(56) *Transactions,* Am. Inst. Min. Engrs., New York City, $6.
(57) *Colliery Guardian,* London, England, 5d.
(58) *Proceedings,* Engrs.' Soc. W. Pa., 2511 Oliver Bldg., Pittsburgh, Pa., 50c.
(59) *Proceedings,* American Water-Works Assoc., Troy, N. Y.
(60) *Municipal and County Engineering,* Indianapolis, Ind., 25c.
(61) *Proceedings,* Western Railway Club, 225 Dearborn St., Chicago, Ill., 25c.
(62) *American Drop Forger,* Thaw Bldg., Pittsburgh, Pa., 10c.
(63) *Minutes of Proceedings,* Inst. C. E., London, England.
(64) *Power,* New York City, 5c.
(65) *Official Proceedings,* New York Railroad Club, Brooklyn, N. Y., 15c.
(66) *Gas Journal,* London, England, 6d.
(67) *Cement and Engineering News,* Chicago, Ill., 25c.
(71) *Journal,* Iron and Steel Inst., London, England.
(71*a*) *Carnegie Scholarship Memoirs,* Iron and Steel Inst., London, England.
(72) *American Machinist,* New York City, 15c.
(73) *Electrician,* London, England, 18c.
(74) *Transactions,* Inst. of Min. and Metal., London, England.
(75) *Proceedings,* Inst. of Mech. Engrs., London, England.
(77) *Journal,* Inst. Elec. Engrs., London, England, 5s.
(83) *Gas Age,* New York City, 15c.
(85) *Proceedings,* Am. Ry. Eng. Assoc., Chicago, Ill.
(86) *Engineering and Contracting,* Chicago, Ill., 10c.

(87) *Railway Maintenance Engineer,* Chicago, Ill., 10c.
(89) *Proceedings,* Am. Soc. for Testing Materials, Philadelphia, Pa., $5.
(90) *Transactions,* Inst. of Naval Archts., London, England.
(91) *Transactions,* Soc. Naval Archts. and Marine Engrs., New York City.
(92) *Bulletin,* Soc. d'Encouragement pour l'Industrie Nationale, Paris, France.
(93) *Revue de Métallurgie,* Paris, France, 4 fr. 50.
(96) *Canadian Engineer,* Toronto, Ont., Canada, 10c.
(98) *Journal,* Engrs., Soc., Pa., Harrisburg, Pa., 30c.
(99) *Proceedings,* Am. Soc. of Municipal Improvements, New York City, $2.
(100) *Professional Memoirs,* Corps of Engrs., U. S. A., Washington, D. C., 50c.
(101) *Metal Worker,* New York City, 10c.
(103) *Mining and Scientific Press,* San Francisco, Cal., 10c.
(104) *The Surveyor and Municipal and County Engineer,* London, England, 6d.
(105) *Chemical and Metallurgical Engineering,* New York City, 25c.
(106) *Transactions,* Inst. of Min. Engrs., London, England, 6s.
(107) *Schweizerische Bauzeitung,* Zürich, Switzerland.
(109) *Journal,* Boston Soc. C. E., Boston, Mass., 50c.
(110) *Journal,* Am. Concrete Inst., Philadelphia, Pa., 50c.
(111) *Journal of Electricity,* San Francisco, Cal., 25c.
(113) *Proceedings,* Am. Wood Preservers' Assoc., Baltimore, Md.
(114) *Journal,* Institution of Municipal and County Engineers, London, England, 1s. 6d.
(115) *Journal,* Engrs.' Club of St. Louis, St. Louis, Mo., 35c.
(116) *Blast Furnace and Steel Plant,* Pittsburgh, Pa., 15c.
(117) *Engineering World,* Chicago, Ill.
(118) *Times Engineering Supplement,* London, England, 2d.
(119) *Landscape Architecture,* Harrisburg, Pa., 50c.
(120) *Automotive Industries,* New York City, 15c.

## LIST OF ARTICLES

**Bridges.**

The Franklin Orleans Bridge.* **(117)** Jan. 15.
A New Bridge Over the Tigris at Baghdad. **(12)** Jan. 17.
The Reconstruction of a Notable Railroad Bridge.* **(15)** Jan. 24.
Design and Construction of Reinforced Concrete Viaducts at Mileages 0.9 and 1.8, North Toronto Subdivision, of the Canadian Pacific Railway.* B. O. Eriksen. **(5)** Feb.
Engineering Problems in Viaduct Construction.* Harry Gardner. **(117)** Feb. 1.
Comparison of Formulas for Computing Parabolic Arcs.* Robert C. Strachan. **(13)** Feb. 13.
Omaha Track-Elevation Bridges Vary in Type to Meet Local Conditions.* **(13)** Feb. 20.
Periodic Inspection of Bridges. Herbert C. Keith. (Extract from paper read before Brooklyn Engrs.' Club.) **(86)** Feb. 26.
La Reconstruction des Ponts en Maçonnerie Détruits au Cours des Hostilités.* Lutton. **(33)** Jan. 11.

**Electrical.**

Cooling of Electric Motors, with Special Reference to Totally-Enclosed Machines.* P. A. Mossay. **(106)** Dec., 1918.
Coal Handling Appliances at the Coventry Electricity Works.* George Frederick Zimmer. **(11)** Jan. 10.
Some Details of Conveyors and Elevators.* W. H. Atherton. **(73)** Jan. 10.
Electrothermic Processes.* **(26)** Jan. 10.
Intensive Lighting Will Increase Production. Wm. A. Durgin. (Abstract of paper read before Illuminating Engrs.) **(117)** Jan. 15.
Arrangement of Power Conductors.* **(111)** Jan. 15.
Phase-Displacement and Its Relation to Methods of Charging for Power.* H. Bussmann. **(73)** Jan. 17.
The Optimum Secondary Capacity of an Induction Coil. E. Taylor Jones. **(73)** Jan. 17.
Methods of Balancing Rotors.* C. C. Brinton. (Abstract of article in *Electric Journal.*) **(73)** Jan. 24.
Operation of Interpole Machines.* G. W. N. Harrison. (Abstract of paper read before Assoc. of Min. Elec. Engrs.) **(22)** Jan. 24.
The Maximum Primary Potential in an Induction Coil. E. Taylor Jones. **(73)** Jan. 24.
Arc-Welding Systems.* Otis Allen Kenyon. **(27)** Jan. 25.
Pumping Plant and Electrical Equipment at Balboa Shops, Canal Zone.* R. D. Gatewood. **(64)** Jan. 28
Electricity in the Docks and Warehouses of the Port of London Authority. **(73)** Serial beginning Jan. 31.

* Illustrated.

**Electrical—(Continued).**

A Hot-Wire Vacuum Meter.* W. Tschudy. (Abstract of article in *Elektrotechnische Zeitschrift.*) (73) Jan. 31.
Telephone Repeaters.* J. E. Statters and W. U. Lonnon. (73) Jan. 31.
Machine Tool Drivers: Motors and Controllers. H. W. Tice. (2) Feb.
The Dielectric Strength of Air Films Entrapped in Solid Insulation and a Practical Application of the Problem for Alternator Coils and Cables.* F. Dubsky. (42) Feb.
Ionization of Occluded Gases in High-Tension Insulation. G. B. Shanklin and J. J. Matson. (42) Feb.
Abnormal Voltages Within Transformers.* L. F. Blume and A. Boyajiam. (42) Feb.
New Charts for Aerial Suspensions. Joseph N. Le Conte. (111) Feb. 1.
Notes on Demand Meters.* H. W. Richardson. (27) Feb. 1.
Long-Line Phenomena and Vector Locus Diagrams.* Edy Velander. (27) Feb. 1.
The Conductivity of Sea-Water.* H. R. Rivers-Moore. (73) Feb. 7.
Selection and Application of Electric Arc Welding Apparatus.* A. M. Candy. (73) Feb. 7.
The Selection, Installation, and Maintenance of Three-Phase Oil-Cooled Power Transformers.* L. Fokes. (57) Serial beginning Feb. 7.
Photographic Study of Porcelain Insulators.* Harold G. Tufty. (27) Feb. 8.
Determining the Characteristics of Metallic-Electrode Arc Welds.* O. S. Escholz. (17) Feb. 8.
Load Division Between Induction-Type Frequency Changer Sets.* Quentin Graham. (64) Feb. 11.
The Measurement of Maximum Demand.* C. W. Marshall. (26) Feb. 14.
Examples of Pole Guying from Other Fields.* Charles Rufus Harte. (17) Feb. 15.
A Well-Lighted and Well-Ventilated Substation.* S. H. Grauten. (17) Feb. 15.
Modern Office Lighting.* A. L. Powell. (27) Feb. 15.
Generation and Storage of Energy in Magnetos.* Harry F. Geist. (120) Feb. 20.
War-Time Development of Vacuum Tubes.* Ralph Brown. (27) Feb. 22.
Transmission-Line Computations. A. E. Kennelly. (27) Feb. 22.
Projet d'Unification des Filetages des Culots et Supports de Lampes à Vis Edison.* C. Zetter. (92) Nov., 1918.

**Marine.**

Sanitation in Emergency Shipyards.* W. L. Stevenson. (109) Jan.
Coal Handling at Ports.* H. Hubert. (73) Jan. 10.
Pneumatic Handling of Cereals.* C. Bentham. (73) Jan. 10.
Marine Terminal Shed.* H. McL. Harding. (117) Jan. 15.
Floating Crane of 75-Ton Capacity.* (117) Jan. 15.
Pumping Plant and Electrical Equipment at Balboa Shops, Canal Zone.* R. D. Gatewood. (64) Jan. 28.
Manufactured Ships.* J. D. MacBride. (2) Feb.
Electric Welding for Shipbuilding. W. S. Abell. (Abstract of paper read before North-East Coast Inst. of Engrs. and Shipbuilders.) (19) Feb. 1.
The Diesel Engine on Shipboard.* Bruce Lloyd. (111) Feb. 1.
Inland Ship-Steel Fabricating Plants of the Emergency Fleet Corporation.* Leyburn G. Fishach. (13) Feb. 13.
Heat Treatment of Steel for Small Petrol Marine Engines.* (12) Feb. 14.
Shipyard on New Orleans Canal for Building "Unsinkables."* (13) Feb. 27.

**Mechanical.**

Some Economic Considerations in Coke-Oven Practice.* W. Colquhoun. (106) Dec., 1918.
Fuel Blending.* E. W. L. Nicol. (118) Jan.; (57) Jan. 24.
Auto Catch-Basin Cleaning Truck, Cambridge, Mass.* Lewis M. Hastings. (109) Jan.
Ovens and Kilns with a High Thermal Efficiency.* A. Bigot. (Paper read before the Ceramic Soc.) (11) Jan. 17; (57) Jan. 10; (66) Jan. 14.
Unusual Carbonizing Methods. James A. Brown. (Paper read before Michigan Gas Assoc.) (66) Jan. 7.
Air Flow Through Poppet Valves.* Clarke Thomson Research. (Report made to U. S. National Advisory Committee for Aeronautics.) (11) Jan. 10.
Coal-Handling Appliances at the Coventry Electricity Works.* George Frederick Zimmer. (11) Jan. 10.
The Calorimetry of Coal.* (11) Jan. 10.
The Trend of German Aeroplane Design. (From Report issued by Aircraft Production (Technical) Department of the Ministry of Munitions.) (12) Jan. 10.
The Mechanical Handling of Coke.* Alwyne Meade. (73) Jan. 10.
The Wire Rope and Its Uses for Conveying Purposes. (73) Jan. 10.
Steaming Horizontal Retorts. R. J. Rew. (66) Jan. 14.
Pulverized Coal and Its Utilization. H. G. Barnhurst. (117) Jan. 15.

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* Illustrated.

**Mechanical—(Continued).**

Notes on the Manufacture of Briquettes.* E. H. Roberton. (From *Transactions*, Min. Geol. Inst. Ind.) (57) Jan. 17.
Centrifugal Fans and Their Application to Gas Engineering Practice.* Frank S. Townsend. (Abstract of paper read before Midland Junior Gas Assoc.) (66) Jan. 21.
On the Heat Transference in Surface Condensers. Alfred W. Porter. (Paper read before Inst. of Shipbuilders and Engrs. in Scotland.) (11) Serial beginning Jan. 24.
A Machine for Measuring Screws.* P. E. Shaw. (11) Jan. 24.
Manufacture of Sulphuric Acid by the Chamber Process. George Chrisp. (Paper read before Coke Oven Mgrs.' Assoc.) (66) Jan. 28.
Burning Fine Anthracite and Bituminous Coal. (64) Jan. 28.
Optical Projection for Screw-Thread Inspection.* James Hartness. (55) Feb.
The Chemical and Physical Control of Boiler Operation.* E. A. Uehling. (55) Feb.
Aeronautics in the United States, 1918.* George O. Squier. (42) Feb.
Material Handling in a Paper Mill.* Henry J. Edsall. (9) Feb.
Modern Boiler Practice. F. A. Combe. (5) Feb.
New Lime, Potash and Agricultural Pulverized Limestone Works of the Clinchfield Cement Corporation.* Chas. R. Wright. (67) Feb.
Machine Tool Drives: Motors and Controllers. H. W. Tice. (2) Feb.
Spontaneous Combustion. M. W. Franklin. (2) Feb.
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Ammonia Plant at the Stockholm Gas Works.* (66) Feb. 1.
Pulverized Coal for Metallurgical Furnaces.* Charles E. Longenecker. (20) Feb. 6.
Analyzing Body Design at New York Passenger Car Show.* George J. Mercer. (120) Feb. 6.
Combustion of Lignites and High-Moisture Fuels.* T. A. Marsh. (27) Feb. 8.
The Estimation of Benzol in Gas.* (66) Feb. 11.
Toluol Recovery Operations in Greater New York.* W. J. McGurty. (83) Feb. 15.
The Mechanical Equipment of Industrial Buildings.* Charles L. Hubbard. (64) Serial beginning Feb. 18.
Mechanical Equipment of a Modern Hotel.* (64) Feb. 18.
A New Method of Gang Drilling.* (20) Feb. 20.
Small Inlet Valves Satisfactory in Overhead Valve Design.* (120) Serial beginning Feb. 20.
Ricardo Engine "Made Good" in Tanks. (120) Feb. 20.
Water Circulation in Boilers. A. D. Williams. (64) Feb. 25.
How Much Should a Flywheel Weigh? Rufus T. Strohm. (64) Feb. 25.
Experimental Design and Testing of Airplane Ribs.* George B. Fuller and Lessiter Milburn. (120) Feb. 27.
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Tests of Airplane Radiators.* P. M. Heldt. (120) Feb. 27.
The Carburetion Temperature of Oil Mixtures. C. A. Norman. (120) Feb. 27.
Les Terrains Pétrolifères au Maroc.* Moussu. (92) Sept., 1918.
Les Combustibles Liquides. A Guiselin. (32) Oct., 1918.
Notes sur l'Utilisation des Combustibles Pauvres par la Société des Houillères de Montrambert. Pigeot. (92) Nov., 1918.
La Verrerie de Laboratoire en Angleterre. A. Livache. (92) Nov., 1918.
Emploi du Pétrole Lampant et des Huiles Lourdes dan les Moteurs à Explosion à Basse Compression, Procédés Bellem et Brégéras.* (33) Nov. 30, 1918.
L'Emploi du Gaz dans les Automobiles.* A. Grebel. (33) Feb. 1.

**Metallurgical.**

Arc-Welding Systems.* Otis Allen Kenyon. (27) Jan. 25.
The Smelting and Refining of Cobalt Silver Ore. Sydney B. Wright. (103) Jan. 25.
The Heat Treatment of Aeroplane Parts.* Fred Grotts. (62) Feb.
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Effect of Heat Treatment on Bronze.* F. F. Hausen and O. A. Knight. (20) Feb. 6.
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The Strip Mills of Trumbull Steel Co.* (20) Feb. 20.
La Métallurgie française, son passé, son avenir. Léon Guillet. (32) Apr., 1918.
Four Electrique Permettant d'Obtenir une Température Uniforme. (33) Jan. 18.

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The French Baby Renault Tank.* W. F. Bradley. (120) Feb. 27.
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The Relation Between the Calorific Values and the Ash-Yields of Coal-Samples from the Same Seam. Thomas James Drakeley. (106) Dec., 1918.
Electric Winding Engine Calculations.* (57) Jan. 10.
Safety Lamp Gauges.* T. J. Thomas. (57) Jan. 10.
An Electric Safety Lamp Record.* W. H. Ball. (Abstract of paper read before National Assoc. of Colliery Managers.) (22) Jan. 24.
Modern Tipple Equipped with a Simple Balanced Horizontal Screen.* Frank J. Schraeder. (45) Jan. 30.
Chain Making and Repairing in the Mine Blacksmith Shop.* J. T. Springer. (45) Jan. 30.
Mine Ventilating Plant.* (12) Jan. 31.
The Eudiogrisoumeter Gas Tester.* E. Hauser. (57) Jan. 31.
Impurities in Raw Coal and Their Removal. T. J. Drakeley. (57) Jan. 31.
The Preparation of Sand and Gravel.* Raymond W. Dull. (67) Feb.
Standardization of Mine Cars in Metal Mines.* R. M. Raymond. (Paper read before National Safety Council.) (13) Feb. 1.
A Mine Latrine.* (103) Feb. 1.
Safety Gate Protection at Mine Shaft.* R. P. Hines. (45) Feb. 6.
Mudding Coal at St. Eloy, France.* M. A. Plassard. (Abstract of article in *Bulletin* de la Société de l'Industrie Minérale.) (45) Feb. 6.
A Study of Shoveling as Applied to Mining.* G. Townsend Harley. (45) Serial beginning Feb. 13.
Effect of the Velocity of Ventilating Current Upon Mine Explosions.* G. S. Rice and W. L. Egy. (45) Feb. 13.
Concreting Prospect Drill Holes.* Roy H. Poston. (16) Feb. 15.
Bradford Coal Breaker and Preliminary Mechanical Cleaner.* (45) Feb. 20.
Inclined-Shaft Timbering and a Method of Alignment.* Arthur Neustaedter. (16) Feb. 22.
Explosives.* Robert S. Lewis. (103) Feb. 22.
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Water Supply at Coal Mines.* Carl Scholz. (45) Feb. 27.
Regarding Longwall.* F. A. Pocock. (45) Feb. 27.
Timbering in English Mines.* (Abstract of paper read before National Assoc. of Colliery Managers of Great Britain.) (45) Feb. 27.
Machine Allemande pour le Creusement des Tunnels.* Francis Schmitt. (33) Nov. 30, 1918.

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Physical Chemistry and Its Bearing on the Chemical and Allied Industries. James C. Philip. (Cantor Lectures.) (29) Serial beginning Jan. 3.
The Valuation and Methods of Analysis of Spent Oxide. Harold G. Colman and E. W. Yeoman. (66) Jan. 14.
The Workers' Interest in Costing. M. Webster Jenkinson. (Abstract of paper read before Industrial Reconstruction Council.) (22) Jan. 31.
Efficiency and Other Factors for Success. Lightner Witmer. (2) Feb.
Modern Applications of Photography.* Alfred B. Hitchins. (3) Feb.
Graphic Analysis of an Overtime Problem. R. von Huhn. (9) Feb.
The Conductivity of Sea-Water.* H. R. Rivers-Moore. (73) Feb. 7.
Labor Saving Devices in Railroad Offices.* (18) Feb. 8.
Hot Wire Anemometry. J. S. G. Thomas. (From *Journal* of the Soc. of Industrial Chemistry.) (19) Feb. 15.
Le Congrès du Génie Civil. (92) Sept., 1918.
Quelques Réflexions sur les Formules de Salaire Moderne.* Carvallo. (33) Nov. 30, 1918.
L'Emploi du Cyanogène et de ses Derivés à la Guerre.* Nicolas Flamel. (33) Feb. 1.

**Municipal.**

Town Planning. Thomas Adams. (96) Feb. 13.

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* Illustrated.

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The Selection and Proper Utilization of Lumber in Car Construction.* Herman von Schrenk. (61) Dec. 16, 1918.
Alternating Current Signalling.* (21) Jan.
Industrial Electric Trucks, Tractors and Narrow-Gauge Locomotives.* Raymond J. Mitchell. (73) Jan. 10.
Los Angeles $10 000 000 Terminal.* (117) Jan. 15.
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Heaviest 2-10-2 Type Built for Pennsylvania Lines.* (15) Jan. 24.
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New Philadelphia & Reading Coaling Station.* (18) Feb. 1.
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# PAPERS AND DISCUSSIONS

MARCH, 1919

Vol. XLV MARCH, 1919. No. 3.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

# PAPERS AND DISCUSSIONS

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# PAPERS AND DISCUSSIONS

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## ON A NEW PRINCIPLE IN THE THEORY OF STRUCTURES*

By George F. Swain, Past-President, Am. Soc. C. E.

Synopsis.

This paper explains what is believed to be a new principle in the theory of structures, which has interesting and important applications. It is known that there is little new under the sun, and it may be that this principle has been known, and published elsewhere, but the writer has not seen it, and has arrived at it independently, from his own reflections on the subject.†

### 1.—Deflection of a Point.

The deflection of any point, $A$, of any structure may be found by a well-known formula, first published in America by the writer in 1883.‡ This formula is

$$\Delta = \sum \frac{s\,t\,l}{EA} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)\S$$

* This paper will not be presented for discussion at any meeting of the Society, but written communications on the subject are invited for subsequent publication in *Proceedings*, and with the paper in *Transactions*.

† In Mohr's "Abhandlungen aus dem Gebiete der Technischen Mechanik," p. 425, this principle is hinted at, but it is not fully explained or its general applicability shown. The same thing is referred to in Grimm's book on Secondary Stresses, but incompletely elucidated.

‡ In a paper, entitled "On the Application of the Principle of Virtual Velocities to the Determination of the Deflection and Stresses of Frames," in the *Journal* of the Franklin Institute.

§ "If this expression causes confusion in the mind of the reader by reason of the fact that the left member is a length while the right member is apparently a force times a length, it is only necessary to remind him that in reality the left member is a length times a unit force; or, differently stated, since $t$ is the stress due to a unit force, it may be considered as a stress due to any given force divided by that force, and, therefore, is a ratio. At any rate, the equation as it stands is perfectly correct."

in which $t$ = stress in any member due solely to a load of unity acting at the point the deflection of which is desired, under the given actual loads, in the direction in which said deflection is desired;

$s$ = stress in the same member, due solely to the given actual loads;

$l$ = length of the same member;

$A$ = area of the same member;

$E$ = modulus of elasticity of the same member.

This formula, as is well known, may be applied, not only to finding the deflection of a joint of a framed structure, but also to finding the deflection of any point of a beam. In the latter case, the area, $A$, must be replaced by an infinitesimal area, $da$, and the stresses, $s$ and $t$, must be the stresses on such area. If the case is one of pure flexure, with no resultant axial force on any section, and if $M_t$ is the bending moment due solely to the force, unity, and $M_s$ is the bending moment due to the actual loads, at any given section, the formula becomes

$$\Delta = \int \frac{M_s M_t \, d\, l}{E\, I} \qquad (2)$$

the integral being extended over the entire length.

The principle now to be explained is a similar one which affords a means of finding the rotation of the axis of any piece at any point.

## 2.—Angular Rotation of the Axis of a Piece at a Point. (The New Principle).

In addition to finding the deflection of any point of a structure in any given direction, it is often desired to find the angular rotation at a point, *i. e.*, the change of direction of the axis of a piece. This may be obtained by a general method analogous to that used for finding the deflection.

Let it be desired to find the angular rotation, or change of direction of the axis of a piece, at a given point, $A$, due to any given loads. At the given point apply only a couple the moment, $M$, of which equals unity, and let the corresponding angular rotation, $\alpha$, at $A$ be first determined by the method of work. (It may be thought a contradiction, or an impossibility, to apply a couple at a point, but this obviously is the same as applying two very large forces a very short distance apart.

or two forces each equal to $\frac{1}{dx}$ at a distance, $dx$, apart. This is perfectly conceivable.) The work done by the couple the moment of which is $M = 1$, if gradually applied, will obviously be $\frac{\alpha}{2}$, since the couple may be considered to consist of forces of unity a unit distance apart, and its average value is $\frac{1}{2}$. The only outer forces being this couple, the work of these outer forces is $\frac{\alpha}{2}$, and this must equal the work of the inner forces. On any bar or fiber having a uniform stress intensity throughout its area and length, due to the applied moment, $M = 1$, let $r$ equal the total direct stress on the bar or fiber and $\Delta l$ its change of length. Then the equation between the work of the outer forces and that of the inner forces is

$$\frac{\alpha}{2} = \sum \frac{r}{2} \text{ (change of length), or } \alpha = \Sigma r \text{ (change of length).}$$

Now, as in the case of deflection, it is clear that the deformation is a purely geometrical phenomenon, and that any change of length of a bar or fiber, whatever its cause, will produce the same angular rotation at $A$. Hence, if for "change of length" in the above formula, which is the change of length due to $M = 1$ at $A$, we substitute the change of length due to any given loading, the formula will give the angular rotation at $A$ due to the given loading, or

$$\alpha = \sum \frac{r s l}{E A} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

in which, for any given bar or fiber,

$E$ = modulus of elasticity;

$A$ = area;

$l$ = length;

$r$ = stress on the area, $A$, due to the couple, $M = 1$, at the given point in a given sense;

$s$ = stress on the area, $A$, due to the applied loads.

The applied couple, $M$, may be applied with either a right-handed or left-handed direction of rotation. If $\alpha$ comes positive, this means that the given loads produce a rotation in the same direction as that assumed for $M$.

In using this equation, tension and compression, of course, should be distinguished in sign, carefully using one of these terms consistently as positive and the other as negative.

If the stresses include bending stresses, the elementary fibers, $da$ in area and $dl$ in length, must be taken.

The formula shows the effect of direct stresses only, shearing effects being neglected.

In applying the couple, $M = 1$, bending stresses may be produced in a bar, in addition to a direct stress in the same bar. The applied loads may produce bending or direct stresses, or both, in any bar. In such cases, for any fiber, $s$ and $r$ are the stresses on an area, $da$.

In general, if the applied loads cause in any bar at any section a direct force, $T_s$, and a flexural moment, $M_s$, the value of $s$ will be

$$s = \left(\frac{T_s}{A} + \frac{M_s y}{I}\right) d a$$

and if the couple, $M = 1$, produces in the same bar and section a direct force, $T_r$, and a moment, $M_r$, the value of $r$ will be

$$r = \left(\frac{T_r}{A} + \frac{M_r y}{I}\right) d a.$$

The value of the differential, $d\alpha$, therefore, will be

$$d\alpha = \left(\frac{T_s d a}{A} + \frac{M_s y d a}{I}\right)\left(\frac{T_r d a}{A} + \frac{M_r y d a}{I}\right)\frac{d l}{E d a}$$

$$= \frac{1}{E}\left[\frac{T_s T_r d a . d l}{A^2} + \frac{T_s M_r y . d a . d l}{A I} + \frac{T_r M_s y . d a . d l}{A I} + \frac{M_s M_r y^2 . d a . d l}{I^2}\right]$$

It is supposed that every bar is straight, with one principal axis of each cross-section in the plane of the applied loads, in which plane also the couple, $M = 1$, is applied. $I$ is the moment of inertia about the principal axis perpendicular to that plane, which, of course, passes through the center of gravity of the section, so that $\int y\, d a = 0$.

This differential refers to an infinitesimal length, $dl$, of any fiber of area, $da$, in any bar, and must be integrated over the cross-section, then over the length of the bar, and the sum of the results taken. The final result will easily be seen to be, if $A$ is constant throughout the length of each bar,

$$\alpha = \Sigma \frac{T_s T_r l}{E A} + \Sigma \int_0^l \frac{M_s M_r d l}{E I} \quad \ldots\ldots\ldots\ldots (4)$$

The forces, $T_r$ and $T_s$, are the direct forces acting in any bar, and are supposed to be constant throughout its length; and the moments, $M_r$ and $M_s$, are the bending moments at any section of any bar. Each of the forces, $s$ and $r$, in Equation (3) may, in any bar, represent a direct stress only, or flexural stress only, or both. The following results clearly follow from Equation (4):

*1.*—If, in any bar, either the actual load system, or the applied moment, $M = 1$, causes a direct stress only, and the other a flexural stress only, that bar may be neglected in the computation; for the value of $\alpha$ for that bar is zero.

*2.*—The flexure in any bar may be neglected unless both the actual loads and the applied moment, $M = 1$, cause flexural stress in it.

*3.*—The direct stress in any bar may be neglected unless both the actual loads and the applied moment, $M = 1$, cause a direct stress in it.

*4.*—If the case is one in which there is only flexural stress in the bars, without direct stress, the formula becomes

$$\alpha = \Sigma \int_0^l \frac{M_s M_r . dl}{E I} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

*5.*—If $A$ as well as $T$ varies along the length of any bar, the formula becomes

$$\alpha = \Sigma \int_0^l \frac{T_s T_r . dl}{E A} + \Sigma \int_0^l \frac{M_s M_r . dl}{E I} \quad \ldots\ldots\ldots\ldots (6)$$

These principles apply in using Equation (1), to determine deflection, as in using Equation (3), to determine rotation.

### 3.—Illustrations of Angular Rotation.

Although this method would seldom or never be used to find the slope of a beam exposed to flexure, this case may be illustrated to show the applicability of the method.

*Case I.—Slope of a Beam Fixed at One End.*—Let it be desired to ascertain the slope of the free end of a beam of constant section (Fig. 1), fixed at one end and loaded at the other with a load, $P$. The load, $P$, produces on any section, distant $x$ from the end, a moment, $M_s = -Px$. The applied couple, $M = 1$, at the free end, if acting in the sense shown, likewise produces

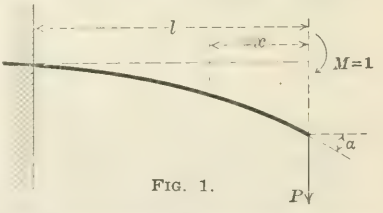

Fig. 1.

a moment at the same section, $M_r = -1$. There is no resultant direct stress on any cross-section. Hence, by Equation (4)

$$\alpha = \int_0^l \frac{P x\, dx}{E I} = \frac{P l^2}{E I} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

which is the well-known value.

Again, let it be desired to find the slope at the end when a couple with moment $= M_0$ is applied at the end:

$$M_s = -M_0$$
$$M_r = -1$$
$$\text{therefore } \alpha = \frac{M_0 l}{E I} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

This result is obtained with equal (but no greater) ease by the moment-area method.

*Case II.—The Slope at the Ends of a Simple Beam Supported at Both Ends.—(a).*—With a single concentrated load (Fig. 2):

Let it be desired to obtain the slope ($\alpha$) at the right end of the beam of constant section shown in Fig. 2, which also shows the moment curve for $M_s$.

Then, clearly,

$M_s = \frac{P x (l-a)}{l}$ from left abutment to $P$,

$M_s = \frac{P a (l-x)}{l}$ from right abutment to $P$,

$M_r = \frac{x}{l}$

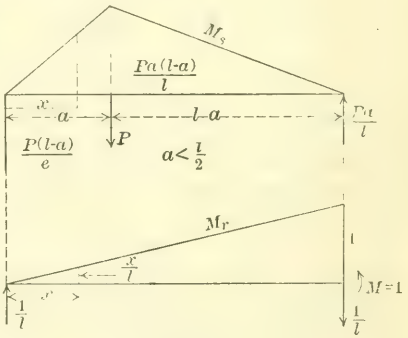


FIG. 2.

$$\text{Then } \alpha = \frac{1}{E I} \int_0^a \frac{P (l-a)}{l^2} \cdot x^2\, dx + \frac{1}{E I} \int_a^l P \frac{a}{l^2} (l x - x^2)\, dx$$

$$= \frac{P a}{6 E I l} \cdot (l^2 - a^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

in the direction shown, that is downward to the left.

This is the simplest method of obtaining this result.

The slope at the load ($\alpha_l$) may be obtained easily, by this method, by applying $M = 1$ at the load; thus (Fig. 3):

$M_s = \dfrac{P\,x\,(l-a)}{l}$ from left abutment to load,

$M_s = \dfrac{P\,a\,x_1}{l}$ from right abutment to load,

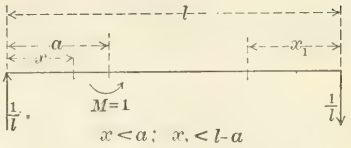


Fig. 3.

$M_r = \dfrac{x}{l}$ from left abutment to load,

$M_r = -\dfrac{x_1}{l}$ from right abutment to load,

$$\alpha_l = \frac{1}{E\,I}\int_0^a \frac{P\,x^2\,(l-a)\,d\,x}{l^2} - \frac{1}{E\,I}\int_0^{l-a} \frac{P\,a\,x_1^{\,2}\,d\,x}{l^2}$$

$$= \frac{P\,a\,(l-a)(2\,a-l)}{3\,E\,I\,l}$$

This is a negative quantity, showing that at the load the axis slopes in a contrary direction to that indicated by the applied moment, that is, it slopes downward to the right.

The point where the axis is horizontal may be easily found by this method. Let this point be distant $z$ from the right end, that is, in the longer segment; and let a moment, $M = 1$, be applied there. The slope there being zero, find $\alpha_0 = 0$, as follows:

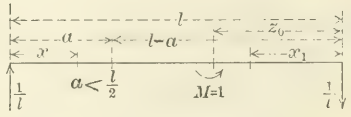


Fig. 4.

The values of $M_s$ and $M_r$ will be as follows (Fig. 4):

Between left end and load: $M_s = \dfrac{P\,x\,(l-a)}{l}$

$$M_r = \frac{x}{l}$$

Between right end and $z_0$: $M_s = \dfrac{P\,a\,x_1}{l}$

$$M_r = -\frac{x_1}{l}$$

Between $z_0$ and load: $M_s = \dfrac{P\,a\,x_1}{l}$

$$M_r = -\frac{x_1}{l} + 1$$

$$E\,I\,\alpha_0 = 0 = \int_0^a \frac{P\,x^2\,(l-a)}{l^2}\,dx - \int_0^{z_0} \frac{P\,a\,x_1^2}{l^2}\,dx_1 - \int_{z_0}^{l-a} \frac{P\,a\,x_1^2}{l^2}\,dx_1$$

$$+ \int_{z_0}^{l-a} \frac{P\,a\,x_1}{l}\,dx_1, \text{ or } z_0 = \sqrt{\frac{l^2 - a^2}{3}}$$

(*b*)—To find slope at the right end due to a moment, $M$, at the left end, causing compression in the top fibers (Fig. 5):

$$M_s = \frac{M_1\,(l-x)}{l}$$

$$M_r = \frac{x}{l}$$

$$\alpha = \int_0^l \frac{M_1\,x\,(l-x)\,dx}{l^2\,E\,I}$$

$$= \frac{M_1\,l}{6\,E\,I} \quad \ldots\ldots\ldots\ldots (10)$$

acting in the direction of the moment, $M = 1$, or downward to the left.

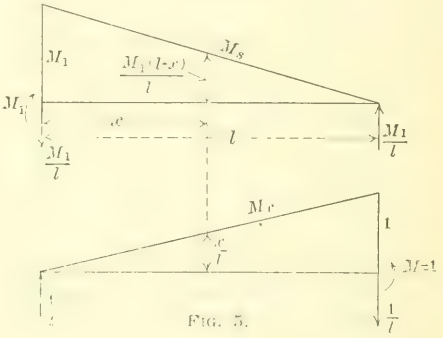


FIG. 5.

(*c*).—To find the slope at the right end due to a moment, $M_2$, at the right end, causing compression in the top fibers (Fig. 6):

$$M_s = \frac{M_2\,x}{l}$$

$$M_r = \frac{x}{l}, \text{ as before,}$$

$$\alpha = \int_0^l \frac{M_2\,x^2\,dx}{l^2\,E\,I} = \frac{M_2\,l}{3\,E\,I}. \quad (11)$$

downward to the left.

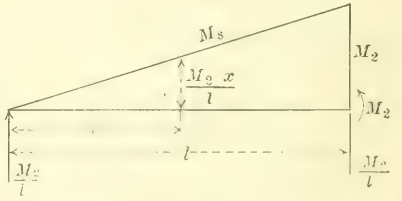


FIG. 6.

*Case III.—The Continuous Girder.—Theorem of Three Moments.*—This principle affords what the writer believes to be the simplest method of demonstrating the Theorem of Three Moments, which follows immediately from Case II. See Fig. 7.

Fig. 7 shows two consecutive spans of a continuous girder, $l_{n-1}$ and $l_n$, each with a single concentrated load in it. The span, $l_{n-1}$, is exposed to the action of its load, and to moments, $M_{n-1}$ and $M_n$, at the supports. In addition, the level of the support $n$-1, may be lowered so that it is $h_{n-1}$ above a base line, while the support, $n$, is $h_n$ above that base. The

slope at $n$, in the direction downward to the left, resulting from $P_{n-1}$, $M_{n-1}$, $M_n$, and the change of level of supports will be, from Equations (9), (10), and (11):

$$\alpha_n = \frac{P_{n-1}\, a_{n-1}\,(l^2_{n-1} - a^2_{n-1})}{6\,E\,I\,l_{n-1}} + \frac{M_{n-1}\,l_{n-1}}{6\,E\,I} + \frac{M_n\,l_{n-1}}{3\,E\,I} + \frac{h_n - h_{n-1}}{l_{n-1}} \cdot (12)$$

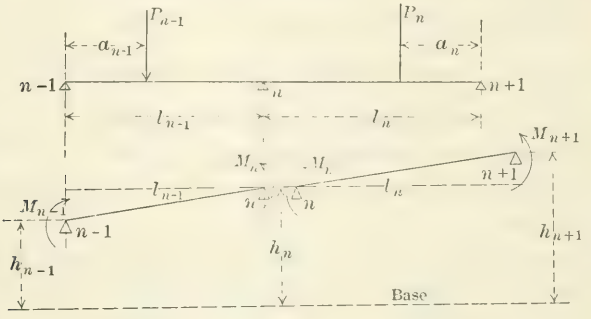


FIG. 7.

The span, $l_n$, is likewise exposed to the action of $P_n$, and of moments, $M_n$ and $M_{n+1}$, and also the support, $n+1$, may be raised above $n$. Under these conditions, the slope at $n$, in a direction downward to the right, will be

$$\alpha'_n = \frac{P_n\, a_n\,(l_n^2 - a_n^2)}{6\,E\,I\,l_n} + \frac{M_{n+1}\,l_n}{6\,E\,I} + \frac{M_n\,l_n}{3\,E\,I} - \frac{h_{n-1} - h_n}{l_n} \ldots . (13)$$

But, if the beam is continuous, $\alpha_n = -\alpha'_n$, or $\alpha_n + \alpha'_n = 0$; hence, for a series of loads, $P_{n-1}$ and $P_n$,

$$M_{n-1}\,l_{n-1} + M_{n+1}\,l_n + 2\,M_n\,(l_{n-1} + l_n) = 6\,E\,I\left(\frac{h_{n+1} - h_n}{l_n} - \frac{h_n - h_{n-1}}{l_n}\right)$$

$$- \sum \frac{P_n\, a_n}{l_n}\,(l_n^2 - a_n^2) - \sum \frac{P_{n-1}\, a_{n-1}}{l_{n-1}}\,(l^2_{n-1} - a_{n-1})^2 \ldots (14)$$

which is the most general form of the Theorem of Three Moments.

*Case IV.—Slope ($\alpha$) at the Foot of One Post of a Rigid Rectangular Bent Supported on Pins, and One Pin on Rollers.*—In Fig. 8, owing to the rollers, there are no horizontal reactions at the supports. By symmetry, each vertical reaction is $\frac{P}{2}$.

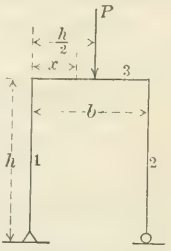


FIG. 8.

The applied load, $P$, produces, in each post, merely a compression, $\frac{P}{2}$; and, in the upper piece, flexure, with a triangular moment diagram having a center ordinate, $\frac{P\,b}{4}$.

The applied couple, $M = 1$, produces (Fig. 9) in the left post a compression of $\frac{1}{b}$; and in the right post a tension of $\frac{1}{b}$, together with a uniform bending moment of $M = 1$ at each point, and in the upper piece a bending moment causing compression in the top fibers, and varying uniformly from zero at the left support to 1 at the right support.

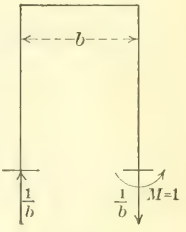

FIG. 9.

From Equation (2) we find, numbering the parts as shown,

$$\alpha = -\frac{P\,h}{2\,b\,E_1\,A_1} - \frac{P\,h}{2\,b\,E_2\,A_2} + \int_0^{\frac{b}{2}} \frac{P\,x^2\,d\,x}{2\,b\,E_3\,I_3} + \int_{\frac{b}{2}}^{b} \frac{P}{2}(b - x)\,\frac{x\,d\,x}{b\,E_3\,I_3}$$

$$= -\frac{P\,h}{2\,b\,E_1\,A_1} - \frac{P\,h}{2\,b\,E_2\,A_2} + \frac{P\,b^2}{16\,E_3\,I_3}$$

If, as would generally be the case, $E_1 = E_2 = E_3 = E$, and $A_1 = A_2$,

$$\alpha = \frac{P\,b^2}{16\,E\,I_3}$$

or the same as at the end of the upper beam loaded at the center, as it obviously should be.

*Case V.—A King-Post Truss.*—Let it be required (Fig. 10) to find the angular rotation ($\alpha$) of the end of the top chord, all joints being supposed to be connected by frictionless pins. The load, $P$, is at the center.

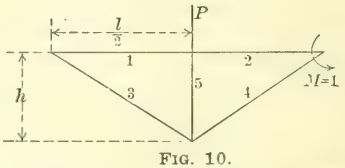

FIG. 10.

For the bars numbered, the values of $l$, $r$, and $s$, are given in Table 1.

The couple, $M = 1$, in the direction shown, causes an upward reaction of $\frac{2}{l}$ on Bar 2 at the left end, and an equal downward reaction at its right end, in other words, a compression on Bar 5 equal to $\frac{2}{l}$, and an upward force of $\frac{2}{l}$ on the end pin at the abutment. This com-

TABLE 1.

| Bar. | Length. | Stress, $r$, due to $M = 1$ at right end of 2. | Stress, $S$, due to the load, $P$. |
|---|---|---|---|
| 1 | $\frac{l}{2}$ | $-\frac{1}{2h}$ | $-\frac{Pl}{4h}$ |
| 2 | $\frac{l}{2}$ | $-\frac{1}{2h}$ + flexure | $-\frac{Pl}{4h}$ |
| 3 | $\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{1}{lh}\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{P}{2h}\sqrt{h^2+\frac{l^2}{4}}$ |
| 4 | $\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{1}{lh}\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{P}{2h}\sqrt{h^2+\frac{l^2}{4}}$ |
| 5 | $h$ | $-\frac{2}{l}$ | $-P$ |

pression on Bar 5 causes tension in 3 and 4 and a downward pull on the pin at the right end of 2 equal to $\frac{1}{l}$, leaving a resultant upward force of $\frac{1}{l}$ on the pin, which must be balanced by a downward reaction exerted by the abutment, as must clearly be the case to balance $M = 1$, independent of any internal stresses. Similarly, the upward reaction at the left abutment is $\frac{1}{l}$.

By the second principle, explained in Paragraph 2, the flexure in Bar 2 does not enter into the equation for slope; hence, the material being uniform, and each bar of constant section and uniform material, if $A_1 = A_2$, and $A_3 = A_4$,

$$E.\alpha = \frac{P\,l^2}{8\,h^2\,A_1} + \frac{P}{l\,h^2\,A_3}\left(\frac{l^2}{4}+h^2\right)^{\frac{3}{2}} + \frac{2\,P\,h}{l\,A_5} \quad \ldots\ldots(15)$$

This may be checked by the usual method, which would be to find first the deflection, $\Delta$, of the top of 5, by Table 2.

$$\Delta = \sum \frac{s\,t\,l}{E\,A} = \frac{1}{E}\left[\frac{P\,l^3}{16\,h^2\,A_1} + \frac{P}{2\,h^2\,A_3}\left(\frac{l^2}{4}+h^2\right)^{\frac{3}{2}} + \frac{Ph}{A_5}\right]$$

$\alpha = \frac{2\,\Delta}{l}$, which is the same as Equation (15).

*Case VI.—A Framed Bent with Columns Rigidly Fixed at the Bottom.*—Consider the bent shown in Fig. 11, and suppose all joints hinged except where the knee-braces meet the columns. The structure

is then statically determined as regard the inner forces, but not as regards the outer forces. Suppose that it is imagined to be made determined by having each column supported on a frictionless pin, and one of them (the right-hand one) on a roller. Under these circumstances, the structure will be entirely statically determined, but the distance between the feet of the columns will change (increase generally), and the axis of the columns at the bottom will rotate. To bring the structure into the condition in which it actually is, apply a horizontal inward force, $H_0$, at the bottom of the right-hand column, a couple with left-handed moment, $M_1$, at the bottom of the right-hand column, and a couple with right-hand moment, $M_2$, at the bottom of the left-hand column. If these three quantities, $H_0$, $M_1$, and $M_2$, can be found, the problem is solved. The conditions which determine them are that the resultant change of span is zero, and that the resultant rotation of the bottom of each column is zero. It remains to formulate these conditions.

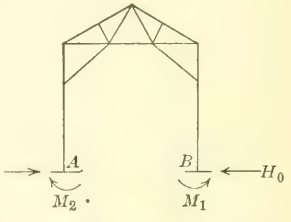

FIG. 11.

In any bar (or fiber, if there is flexure) of the statically determined structure, let

$S_0$ = stress due to the actual loads,
$t$ = " " " an outward force of unity at $B$,
$r_1$ = " " " a right-handed moment of unity at $B$,
$r_2$ = " " " " left-handed " " " " $A$,

Then the actual stress in that bar or fiber will be

$$S = S_0 - H_0 t - M_1 r_1 - M_2 r_2$$

The outward deflection of $B$, which is zero, will be

$$\Delta = 0 = \sum \frac{s\,t\,l}{E\,A} = \sum \frac{s_0\,t\,l}{E\,A} - H_0 \sum \frac{t^2\,l}{E\,A} - M_1 \sum \frac{r_1\,t\,l}{E\,A} - M_2 \sum \frac{r_2\,t\,l}{E\,A} \quad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

The rotation of B in a right-handed direction, which is zero, will be

$$\alpha_1 = 0 = \sum \frac{s\,r_1\,l}{E\,A} = \sum \frac{s_0\,r_1\,l}{E\,A} - H_0 \sum \frac{t\,r_1\,l}{E\,A} - M_1 \sum \frac{r_1^2\,l}{E\,A} - M_2 \sum \frac{r_1\,r_2\,l}{E\,A} \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

TABLE 2.

| Bar. | Length. | Stress, $t$, due to load 1 at top of Bar 5. | Stress, $s$, due to load, $P$, at top of Bar 5. |
|---|---|---|---|
| 1 | $\frac{l}{2}$ | $-\frac{l}{4h}$ | $-\frac{Pl}{4h}$ |
| 2 | $\frac{l}{2}$ | $\frac{l}{4h}$ | $-\frac{Pl}{4h}$ |
| 3 | $\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{1}{2h}\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{P}{2h}\sqrt{h^2+\frac{l^2}{4}}$ |
| 4 | $\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{1}{2h}\sqrt{h^2+\frac{l^2}{4}}$ | $\frac{P}{2h}\sqrt{h^2+\frac{l^2}{4}}$ |
| 5 | $h$ | $-1$ | $P$ |

The rotation of $A$ in a left-handed direction, which is zero, will be

$$\alpha_2 = 0 = \sum \frac{s\, r_2\, l}{E\, A} = \sum \frac{s_0\, r_2\, l}{E\, A} - H_0 \sum \frac{t\, r_2\, l}{E\, A} - M_1 \sum \frac{r_1\, r_2\, l}{E\, A} - M_2 \sum \frac{r_2^2\, l}{E\, A} \quad \ldots\ldots(18)$$

If the material is uniform throughout, $E$ may be cancelled.

The stresses indicated in these equations may all be found by statics, and tabulated, and the summations found. Designating the sums by letters, $a$, $b$, $c$, $d$, $e$, $f$, $g$, $h$, $k$, the equations may be written

$$a = H_0 b + M_1 c + M_2 d \quad \ldots\ldots(16)$$
$$e = H_0 c + M_1 f + M_2 g \quad \ldots\ldots(17)$$
$$h = H_0 d + M_1 g + M_2 k \quad \ldots\ldots(18)$$

in which all the constants are known, and the problem is to find $H_0$, $M_1$, $M_2$.

The solution gives the following values:

$$M_1 = \frac{(a\,d - h\,b)(d\,c - b\,g) - (a\,c - e\,b)(d^2 - k\,b)}{(c\,d - g\,b)^2 - (c^2 - f\,b)(d^2 - k\,b)} \quad \ldots\ldots(19)$$

$$M_2 = \frac{(a\,c - e\,b)(d\,c - b\,g) - (a\,d - h\,b)(c^2 - f\,b)}{(c\,d - g\,b)^2 - (c^2 - f\,b)(d^2 - k\,b)} \quad \ldots\ldots(20)$$

$$H_0 = \frac{a - M_1\, c - M_2\, d}{b} \quad \ldots\ldots(21)$$

These three equations completely solve this case. In any actual case, the values in these equations will be numerical, and can easily be substituted. To obtain a general value of $M_1$, $M_2$, and $H_0$, in any special

case, by this method, is possible, but is long and complicated, and other methods are very likely to be shorter and more easily visualized.

In this, as in all statically undetermined cases, it is necessary, in designing, first to make some assumptions which will make the structure statically determined, design the sections on this assumption, and then use the foregoing equations for a more exact design, repeating the process if necessary.

In the present case, if the applied loads and the outline of the structure are symmetrical about a vertical center line, it is easily seen that $e = h$, $c = d$, $f = k$, and that $M_1 = M_2$, hence

$$M_1 = M_2 = \frac{ac - eb}{2c^2 - gh - fb} \quad \ldots\ldots\ldots\ldots\ldots\ldots (22)$$

$$H_0 = \frac{2ec - a(g + f)}{2c^2 - b(g + f)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (23)$$

The point of inflection in either post, in this case, will be at a height above the base

$$h_0 = \frac{M_1}{H_0} = \frac{ac - eb}{2ec - a(g + f)}.$$

In obtaining any of the sums required, the principles relating to combinations of direct stress with flexure, explained in Paragraph 2, apply.

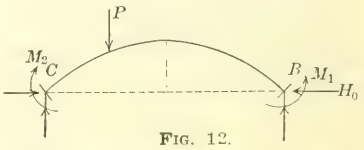

FIG. 12.

*Case VII.—The Arch Without Hinges.*—In this case (Fig. 12) there are three equations to be supplied by elastic conditions, namely:

(1).—The change of span = 0,
(2).— " " " slope at $B = 0$,
(3).— " " " " " $C = 0$.

Suppose, first, the arch to be statically determined as regards the outer forces, by being supported on frictionless pins, and $B$ on rollers. On any bar (or fiber, if there is flexure) of the statically determined structure, let

$S_0$ = stress due to the actual loads;
$t$ = " " " an outward load of unity at $B$;
$r_1$ = " " " a right-handed moment of unity at $B$;
$r_2$ = " " " " left-handed " " " " $C$.

Let the actual thrust ($H_0$), the moment at $B$ ($M_1$), and the moment at $C$ ($M_2$), be assumed to act as shown. Then the equations of Case VI apply here, and the solution is given by Equations (19), (20), and (21), all the quantities in those equations being easily found by statics.

The further discussion and illustration of these results are interesting and valuable, but need not be given here, as the purpose is merely to explain the new principle which, if not first stated, is believed to be first explained, in this paper.

It is not the intention here to do more than explain the principle and illustrate its application. The reader who thoroughly grasps it will find that it may be applied usefully in many ways.

*Case VIII.—Secondary Stresses.*—The principle herein explained may be applied to the determination of the secondary stresses in framed structures, in the following manner:

Let the structure be a frame with assumed frictionless connections, and with bars arranged so as to be statically determined as regards the inner forces. The secondary stresses arise from the fact that, if the joints are riveted, they are far from frictionless, so that unknown bending moments are introduced at the ends of the bars. There is such a bending moment at each end of each bar.

Let $n =$ number of bars,
$m =$ " " joints.

Then, the structure being statically determined with regard to the inner forces, the condition is fulfilled

$$n = 2m - 3$$

Now, as regards the secondary stresses, the only unknown quantities are the bending moments at the ends of the bars, so that

$$x = \text{number of unknown quantities} = 2n.$$

The conditions from which these unknown quantities may be found are, that with rigid connections the angles between the bars at any given joint are unchanged, or, in other words, that the rotation of every bar meeting at a joint is the same.

At all but four of the joints there will be, in general, four bars meeting, if the frame is a simple triangular frame, so that at each such joint there will be three equations. At two joints there will be three bars meeting, and two equations; and at two joints there will be two bars meeting, and one equation. In addition, there is the condi-

tion at each joint that the algebraic sum of the moments at the ends of the bars meeting there must be zero. Hence, the number of equations will be

$$3\ (m - 4) + 4 + 2 + m = 4m - 6 = 2n$$

so that there are just equations enough to determine the unknown quantities.

The foregoing holds thus far for any frame composed of simple triangles like a Warren truss, in Fig. 13, but not for such a truss with secondary bars; but, if the method of developing the truss with secondary bars is considered, the principle will be found to be true for such a truss also.

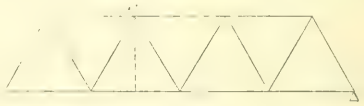

FIG. 13.

Consider the simple Warren truss, as shown in Fig. 13. If, now, it is desired to add a secondary bar, *ab*, by connecting an existing joint, *a*, with some point, *b*, in another bar, *cd*, one new joint is added (*b*), and two new bars (*ab* and *cb* or *bd*). For the original truss

$$n = 2m - 3.$$

If $m_1$ secondary bars are added, such as *ab*, there will be $2m_1$ new bars added, so that

$$n_0 = \text{number of bars} = n + 2\ m_1 = 2\ m - 3$$
$$+ 2\ m_1 = 2\ (m + m_1) - 3$$
$$m_0 = \text{number of joints} = m + m_1$$

and, as before, $n_0 = 2\ m_0 - 3$, or the structure is still statically determined.

As regards secondary stresses, the number of conditions in the original truss was $4\ m - 6$. For each secondary bar added, there is a joint, *b*, added, at which there are three bars meeting, and two conditions, hence there will be $2\ m_1$ additional conditions if $m_1$ secondary bars are added. Also, at each of these joints, *b*, $\Sigma\ M = 0$, which gives $m_1$ more conditions; also, at each joint, *a*, there is one more bar and hence one more condition, which gives $m_1$ more conditions. Hence, the addition of $m_1$ secondary bars gives $4\ m_1$ additional conditions, making the total number of conditions $4\ m - 6 + 4\ m_1$. The number of bars will be $n + 2\ m_1$, and the number of unknown quantities will be

$$2\ (n + 2\ m_1) = 4\ m - 6 + 4\ m_1$$

or the same as the number of conditions.

The stresses due to the moments at the ends of the bars may all be easily computed by statics, and the resulting numerical equations may be solved, in any given case, though general formulas would be difficult to deduce, and are unnecessary.

The effect of eccentricity of the connections may be taken account of by the same method. The stress in any bar is assumed to act in the line joining the ideal joints of the truss. If this line is not through the center of gravity of the cross-section of the bar, it causes a moment at each end, which is a part of the total moment at that end.

In the same way, the effect of pin connections may be taken account of. The friction on the pin when the bar tends to rotate on it as the truss deflects, will cause a moment at the end of the bar, depending on the coefficient of friction and the diameter of the pin. The structure may be computed, first, as if the joints were rigid, and the moment at the end of the bar found. If this moment proves to be less than the frictional moment, the bar will then be actually rigidly fixed at the end, notwithstanding the pin connection. If the moment as found proves to be greater than the frictional moment, the latter is to be taken as the true moment, and the results throughout the truss modified accordingly.

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# PAPERS AND DISCUSSIONS

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## THE EAST CANYON CREEK DAM

By A. F. Parker, M. Am. Soc. C. E.

To be Presented May 7th, 1919.

Synopsis.

This paper describes the design and construction of a concrete dam which depends on its arched form for stability.

The East Canyon Creek Dam, on East Canyon Creek, Morgan County, Utah, is 12 miles above the Town of Morgan and 37 miles from Ogden, Utah. The reservoir formed by the dam stores water for late irrigation of lands in the Salt Lake Valley south of Ogden, and forms a part of the irrigation system owned by the Davis and Weber Counties Canal Company, of Ogden. The mean altitude of the site is 6 000 ft.

The structure is of interest because of its slight appearance and the successful manner in which it stands the test of use. The arch has a length of 128 ft., the radius of its up-stream face varying from 78 to 98.8 ft. The arched portion is 190 ft. high above bed-rock and 145 ft. above the outlet; its thickness is 26 ft. at the bottom and 5 ft. at the top. The arch abuts against a tangent of gravity section on one end, and against a tangent structure of hollow-deck type on the other. The outlet gates are of the full balanced type.

The dam was built during the winter, and the materials available for sand were of very doubtful appearance, containing much fine silt and

Note.—These papers are issued before the date set for presentation and discussion. Correspondence is invited from those who cannot be present at the meeting, and may be sent by mail to the Secretary. Discussion, either oral or written, will be published in a subsequent number of *Proceedings*, and, when finally closed, the papers, with discussion in full, will be published in *Transactions*.

clay. The success of the structure adds to the number of arch dams built that go to demonstrate and sustain the use of the simple formula for the strength of cylinders in computing the dimensions of such dams. The costs of the work are given.

## General.

In 1896 a dam was built on East Canyon Creek, 58 ft. in height above the outlet; in 1900 the height was increased by an addition of 30 ft., and in 1902 it was raised to its ultimate elevation of 100 ft. The first dam formed a reservoir having a capacity of 3 850 acre-ft., and this was increased by the additions to 9 000 and 14 000 acre-ft., respectively.

The old dam was of the rock-fill type, with a steel core. With conditions as they existed at the time this dam was built it is probable that this was the best type to be adopted. It served its purpose for a long time, but finally developed a leakage which ultimately amounted to about 40 sec.-ft. There seemed to be no danger of a break in the dam, but the leak became so great that it threatened its usefulness for storing water. The impossibility of repairing the leak and the need for a greater storage capacity caused the building of a new structure at the lower or down-stream toe of the old dam.

Preliminary surveys were made in 1912. The design and plans of the dam were under discussion for two years, and the contract for construction was let on April 21st, 1915. The dam was completed in June, 1916. Building roads, making plant foundation excavations, and sundry preparations consumed much time, and the first concrete was placed on September 30th, 1915. This resulted in practically all the concrete work being done in the coldest winter weather and under very trying conditions generally.

## Water Supply.

The water-shed has an area of 156 sq. miles and is high, mountainous country, with an elevation of from 6 000 to 9 000 ft. The portion of the stream flow available for storage is that of the winter and the spring floods. The quantity varies greatly, according to the precipitation of the seasons. As nearly as could be determined, there was probably as much as 65 000 acre-ft. available in flush years, with a probable minimum of 20 000 acre-ft. when precipitation was light. The econo-

PLATE I.
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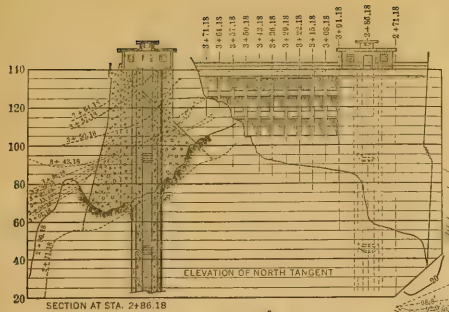
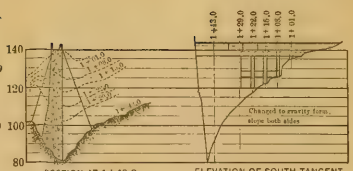
PARKER ON
EAST CANYON CREEK DAM.




SECTION AT STA. 2+86.18

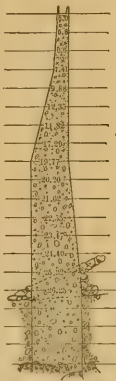



SECTION AT 1+43.0 ELEVATION OF SOUTH TANGENT

SECTION THROUGH SPILLWAY

ARCH DATA AND QUANTITIES

| CONTOUR | CHORD | ARC | ANGLE | $\frac{r}{t}$ = MEAN RAD. |
|---|---|---|---|---|
| 140 | 122.2 | 131.5 | 76° 16′ | 98.8 |
| 130 | " | " | " | " |
| 120 | " | " | " | " |
| 110 | " | " | " | " |
| 100 | " | " | " | " |
| 90 | " | " | " | " |
| 80 | 122.2 | 131.5 | 76° 16′ | 98.8 |
| 70 | 101.5 | 106.6 | 61° 50′ | 98.8 |
| III | 82.3 | 84.87 | 49° 14′ | 98.3 |
| 50 | 74.5 | 76.72 | 47° 46′ | 92.0 |
| 40 | 71.5 | 73.69 | 48° 50′ | 86.48 |
| 30 | 68.5 | 70.63 | 49° 22′ | 82.00 |
| III | 66.0 | 68.12 | 49° 54′ | 78.23 |
| 10 | 65.5 | 67.76 | 51° 44′ | 75.01 |
| 0 | 65.0 | 67.41 | 53° 24′ | 72.34 |
| −10 | 61.0 | 63.10 | 51° 40′ | 70.0 |
| −20 | | | | |
| −30 | | | | |
| −40 | | | | |
| −50 | | | | |



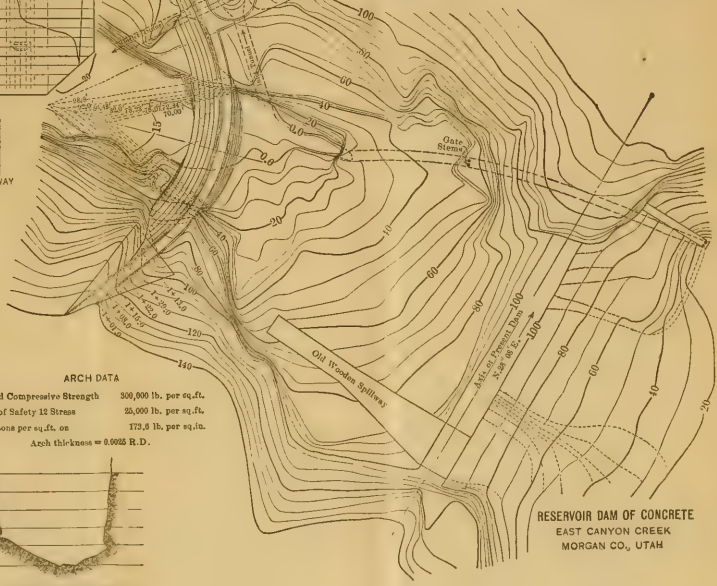
MAXIMUM SECTION

SECTION ACROSS CANYON

ARCH DATA

| | |
|---|---|
| Assumed Compressive Strength | 300,000 lb. per sq.ft. |
| Factor of Safety 12 Stress | 25,000 lb. per sq.ft. |
| or 12.5 tons per sq.ft. on | 173.6 lb. per sq.in. |

Arch thickness = 0.0025 R.D.




RESERVOIR DAM OF CONCRETE
EAST CANYON CREEK
MORGAN CO., UTAH

mical capacity of the reservoir was fixed as 28 000 acre-ft., which called for storage to the 140-ft. contour above the outlet to the old dam.

## Features of the Site.

At the site of the dam a strong, prominent upheaval of conglomerate rock shows above the mountain slopes for several miles. Where the creek cuts through the conglomerate, a short, deep gorge or canyon, with solid rock walls, makes a favorable place for building a dam. The rock canyon is only about 1 500 ft. long, with the up-stream end sharply defined by vertical cliffs, and the lower end gradually tapering off to the general mountain slopes.

The rock is a limestone conglomerate, formed of fragments of rhyolite, sandstone, and limestone cemented together with calcite. The rock lies in beds of greatly varying thickness; the bedding planes are very strongly marked, and have a heavy down-stream dip. There are many soft and disintegrating spots; and some of the bedding planes have thick fillings of rotten rock and clay. Between some of the bedding planes slight stratification shows in the thinner layers, but where the planes are widely separated (sometimes as much as 40 ft.) there are massive layers of conglomerate with no stratification, and they are exceedingly firm and hard.

The sides of the canyon are very irregular, but, in general, are roughly vertical—in places overhanging—for the first 40 to 60 ft., and, above the vertical cliffs, the slopes fall back at varying angles. A casual inspection gives one the impression that the rock is unreliable, both as to strength and water-tightness. A close inspection shows the possibility of finding good sound rock on which to found a dam.

The conformation and quality of the rock fixed the location of the dam at the down-stream toe of the old dam. The body of the old dam precluded the adoption of the best location. It became necessary to locate the dam lower down stream, and even then the excavation cut the toe of the old dam somewhat. It is evident that extending the excavation into the toe of the old dam was a matter of difficulty and grave risk. The fact that the reservoir above the old dam was full of water and that a leak of 40 sec.-ft. existed added to the difficulty and danger. That the work was done successfully is due to the absence of alluvial material. The excavated material was nowhere finer than coarse sand, but most of it consisted of coarse fragments, with many large rocks.

Bed-rock was found 45 ft. below the creek bed, where the average distance between the canyon walls was 45 ft. The surface of the bed-rock was very irregular, being cut with channels and pot-holes, but all smooth and highly polished, evidently by flowing water carrying sand and drift. Some of the pot-holes were as deep as 5 ft., and much larger at the bottom than at the top; and remains of the boulders that ground them out were found in each. There were no cracks or fissures to be found, and the only preparation necessary to make a foundation was some roughening of the polished surface.

## The Design.

The peculiarities of the site plainly indicated the adoption of a dam of the arch type. The location, above several towns and a railroad, where a break would result in a disaster of magnitude, made safety of prime importance. Calculations showed that an arch dam could be built for about one-half the cost of any other type. It was realized that the slight appearance of an arch dam of short radius, as compared with the greater bulk of gravity sections, might cause apprehension as to safety. It is probably this slight appearance that makes so many engineers reluctant to adopt the pure arch type.

From the numerous articles describing arch dams, the many discussions on their design, and the frequency with which lists of arches actually built appear in such articles, one gains the impression that a general doubt exists as to the safety of structures of such slight appearance. However, the fact that so many arch dams—many of strikingly light section and frequently subjected to trying conditions—have been built without a single instance of failure occurring, which cannot be said of any other type, is strong proof of good qualities and safety. The test of actual use shows that arches under water pressure are the safest form that can be built.

All that could be found in print relating to arch dams was studied, and the proposed mathematical treatment was applied to the design of the structure. It was found that in all cases the dimensions necessary to resist the complicated shears, bending, and temperature stresses did not exceed the dimensions computed from the simple formula for the strength of cylinders under pressure, when the unit stress on the masonry was conservative. To decide on a conservative unit stress, one must be guided by the quality of the materials, the importance of the

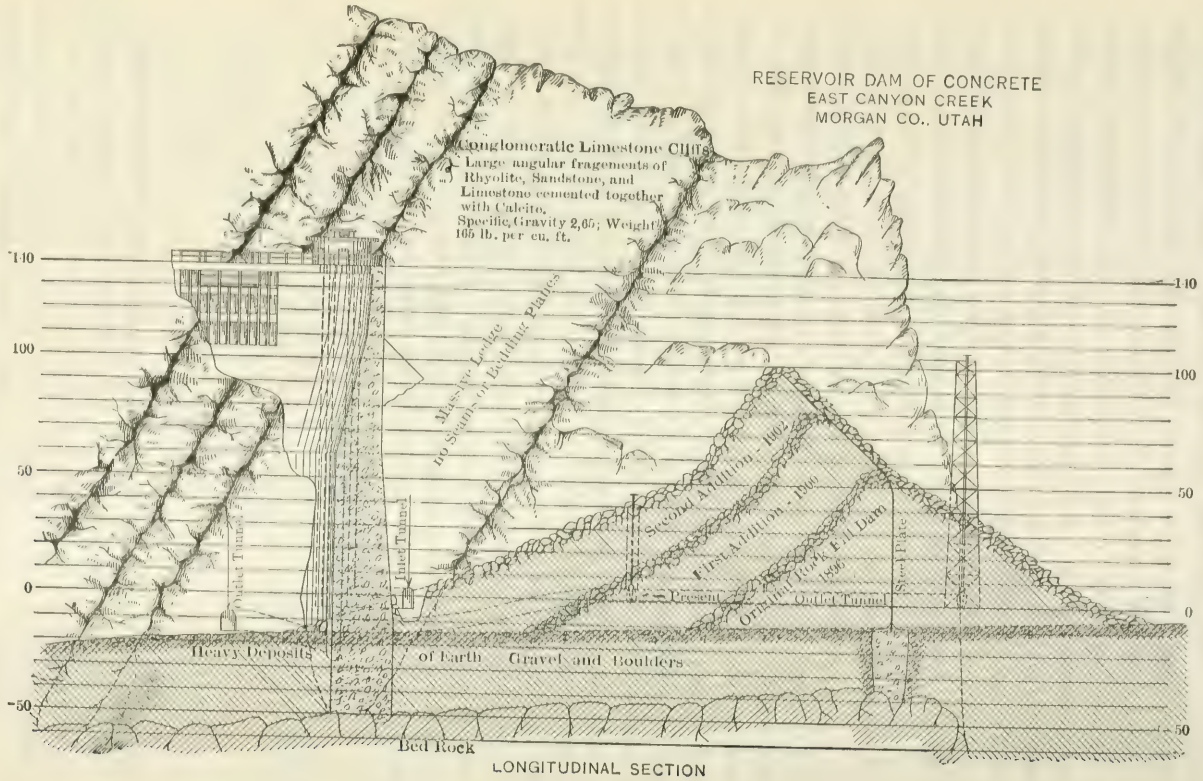

RESERVOIR DAM OF CONCRETE
EAST CANYON CREEK
MORGAN CO., UTAH
Conglomeratic Limestone Cliffs
Large angular fragements of Rhyolite, Sandstone, and Limestone cemented together with Calcite.
Specific Gravity 2,65; Weight 165 lb. per cu. ft.
Massive Ledge no Seams or Bedding Planes
Second Addition - 1902
First Addition - 1900
Present
Original Dam - 1896
Earth Fill Dam
Steel Plate
Outlet Tunnel
Inlet Tunnel
Heavy Deposits of Earth Gravel and Boulders
Bed Rock
140
100
50
0
-50
LONGITUDINAL SECTION

FIG. 1.

structure, etc. Examples are found of arch dams in successful use having stresses ranging from a minimum of 10 tons to a maximum of 61 tons per sq. ft. On account of the importance of the structure, in this case, a stress of 12.5 tons per sq. ft. was adopted.

The thickness of the arch was found by using the simple formula,

$$T = \frac{RP}{S},$$

where $T$ = the thickness of the arch, in feet;
$R$ = the radius of the up-stream side, in feet;
$P$ = the water pressure, in tons per square foot;
$S$ = the stress on the masonry, in tons per square foot.

For practical use, let the depth of water at any point be represented by $D$; it is easily found that $RD = 0.0025$ gives the thickness for a stress of 12.5 tons per sq. ft. The thickness of the arch, in this case, was finally determined by the use of this extremely simple formula.

In the hydrostatic arch, the loading is definite and symmetrically applied, as well as easily determined. The stress is primarily all compression, increasing directly as the depth of the water. Ice thrust, when present, adds a very uncertain amount of compression, and this is best provided against by the use of vertical reinforcement to distribute the stress over a larger area; but the elasticity of the masonry and the supporting rock, the changes due to variations of temperature, the combination of cantilever and gravity action, etc., necessarily produce complicated shear and bending stresses; of such stresses but little is really known, for their determination involves assumptions on which authorities do not agree, and which, in the final analysis, are only the judgments of the designer.

It is to be regretted that there is no way of determining the actual factor of safety in arched dams. All that is now possible is to apply the formulas of theory and build the structure; if it does not fail or develop signs of weakness, the calculations used in the design may be pronounced safe and proper to use in similar cases. Until some arch dam actually fails under pressure, there is nothing to show the true limit between bold and conservative design. In examining published plans of existing gravity dams, does it not sometimes become apparent that, in some instances, the higher central and so most costly part could have been made in the form of an arch with tangent ends of gravity or other

type, according to conditions, without detriment to safety and at considerable saving of cost? The saving in the quantity of foundation excavation alone would be considerable.

It is always desirable to use as little concrete as is consistent with safety. It is variously stated that the minimum quantity of concrete is needed for a given thickness of dam when the central angle of the arch includes about 133°, when the versed sine is one-third of the chord, or when the radius is equal to the chord multiplied by 0.54. In this case it was found impractical to consider the element of the minimum quantity of concrete; it involved producing overhangs in the faces of the arch, and it is probable that cases are rare where it is practical to maintain a constant angle between the limiting radii. Recorded examples of arch dams show that in some cases local increases of thickness have been made in order to give increased strength; in this case no such additions to the calculated thickness was considered necessary, but in places the joining of the arch to the cliffs had small increases of thickness in order to cover cracks and soft places in the rock, and for no other reason.

When the arch is very thick, compared with its length, the matter of arch action is very uncertain. It is known that a structure loses its arch characteristics when the thickness at the crown is too great, compared with the radius and length of arch, but at what point arch action ceases is very uncertain; one authority states that a curved dam will act as an arch if the thickness does not exceed one-half of the radius, and another says one-third. It is probable that in this case the bottom part of the arch acts more as a bulkhead or plug to the canyon, than as an arch.

The sides of the canyon forming the abutments of the arch have such direction as to be nearly parallel with the center line of the included arch angle, instead of being on radial lines, as is to be desired. To cut into the rock sides to give abutments on radial lines was expensive, and, on the north side, such blasting of rock was too near to the tunnels and gate-shaft for safety; the shaft was located close in, for reasons of economy. Therefore, it was decided to trust to the key afforded by the inequalities of the rock—in this instance unusually favorable for a good key—without blasting out any more rock than was necessary for finding good solid abutments, notwithstanding the fact that the line of the rock made an angle with the line of the

resultant of the arch thrust equal to the full angle of repose for masonry. There was placed over such abutments steel dowel pins, of 1-in. square twisted pieces, 4 ft. long, placed one-half in the rock, in grouted holes, and the remainder built into the concrete, one dowel to every 3 ft. vertically and horizontally. Such dowels may not do much good, but they certainly give a look of security.

To fit the arch to the cliffs properly, it was found necessary not only to adopt radii varying in length from 70 to 98.8 ft., but, at Elevation 60, to change the batter from the up-stream to the down-stream side. The batter begins on the up-stream side of the dam at 10 ft. below the level of the old outlet, assumed for convenience as Elevation 0.0, so that the point 10 ft. below has a minus value. The down-stream side is vertical to Elevation 60, where the batter changes to that side, and is continued thence to the top. The calculations for thickness bring the dam section to a point at the top; but the top thickness is assumed in this instance at 5 ft., and the surface batters downward to meet the other batter at Elevation 110, where the thickness is 7.41 ft. More for appearance than anything else, there is a rib at the top, on the down-stream side, of 8 in. projection and 4 ft. deep. On the up-stream side there is a parapet wall, 3.5 ft. high, and opposite is a railing of 1½-in. pipe supported by posts of 3-in. I-beams; provision is made for the expansion and contraction of the pipe.

The length of the dam over all is 273 ft., the south tangent being 43 ft., the arch 128 ft., and the north tangent 102 ft. Up to about Elevation 60 the arch is not more than 65 ft. long, mostly only from 45 to 50 ft. The excavation for bed-rock extended to 45 ft. below the creek bed, or 50 ft. below the old outlet, which was assumed as the zero of elevations. The total height of the dam is 190 ft. From bed-rock to Elevation — 10 the thickness is constant, because of balanced pressures; the use of forms began at Elevation — 10, with a dam thickness of 26.25 ft., but to that level the thickness is from 28 to 30 ft., for in the foundation timbering only the heavy timbers were removed, and the whole space between the lagging was filled with concrete.

The length and radius of the arch was determined by the set of the tangent ends. It was necessary to use tangent ends, for the calculations showed that otherwise a longer radius was needed, and then the ends of the arch would be too nearly parallel with the sides of the canyon; in fact, the dimensions and form adopted showed that the

cost of building would be less than with any other form tried. The most difficult matter involved in the design was to find a balance of the elements involved, at the same time having due regard for economy and sound rock for abutments. This was only accomplished by patience and many trials of different forms and locations.

### The Tangent Ends.

The south tangent of gravity section was first designed as a deck section, but, after the foundation to receive it was blasted out, the contour was changed so much that the gravity section with slopes on both sides was substituted. On the north side the rock fell away in such manner that a proper gravity section could not be built on it where the slope of the structure is down-stream, and it became necessary to adopt a hollow-deck section where the sloping side could be up-stream. The deck is formed of arches below and a straight surface above, set on piers 7 ft. from center to center. The foundations of the tangents, perched on the sides of the cliffs, had dowel pins of the same kind as those used in the arch abutments; there were plenty of them, and they were set into the rock before the concrete was placed.

It being necessary for the tangent ends to receive the thrust of the arch and carry it to the rock sides of the canyon, the hollow spaces in the north tangent required special treatment. Accordingly, two heavy braces or ribs were placed, reaching from pier to pier and to the side of the canyon. The lower brace, at Elevation 115, is 7 ft. wide and 4 ft. high, with a reinforcement of 36 rods of 1-in. square twisted steel; the upper one, at Elevation 122, is 6.25 ft. wide and 3 ft. high, with 20 rods of the same size and kind; the horizontal rods in both beams are surrounded with hoops of $\frac{1}{2}$-in. twisted steel every 12 in. The working floor of the spillway provides for the thrust at the top.

### The Spillway.

The spillway, 42 ft. wide and 5 ft. deep, is in the north tangent. It is fitted with top-hinged, swinging, steel supports or needles, 3.5 ft. from center to center for supporting ordinary plank flash-boards. It is intended that the ordinary operation of the flash-boards shall be by hand, using hooks on the irons placed for that purpose on the boards. For emergency use there is provided means for prying up the needles by using a steel bar kept for that purpose, until the bottom passes the

lower support and allows the needles to swing down stream, thus releasing the boards supported by the needles. In such event the boards released go down stream, and may be lost; but the need for such release is infrequent, and the loss of a few boards of little moment. The spillway apron is from the top of the upper thrust beam to the crest of the spillway; it is arranged to throw the water well away from the dam, where it finds its way to the creek channel without further provision for directing it.

### Contraction Joints.

There are only two contraction joints, and they are placed where the arch abuts the tangents. The north joint begins at Elevation 60 and the other at Elevation 80. One side of the joints was built in advance of the other, and a coating of hot DX-grade California paving asphalt was applied to the surface before the remaining concrete was placed. Across the joint, and 2 ft. back from the up-stream side, a 1½-in. pipe was placed, one half in each side; when these pipes were removed, a 2-in. hole was left, and this was run full of the hot asphalt, as additional security against leakage. The joints, being on true radial lines, had no dowels or reinforcing steel extending across; but heavy offsets were made in the concrete.

### Steel Reinforcement.

No reinforcement was used until Elevation 50 was reached; from that point to the top, 1-in. square twisted steel was placed in 2-ft. squares and 1 ft. back into the concrete on both sides of the arch. The gravity section tangent has no reinforcement, but the deck type of tangent has a reinforcement of ¾ and ½-in. square twisted steel rods. It was decided to use the steel in the manner described as a compromise of apparent demands of the elements involved—the horizontal steel to stiffen the thinner parts of the arch, the vertical to distribute the ice pressures, and all to prevent cracks. It certainly prevented cracks, but more steel may have been used than was strictly necessary. The heavy reinforcement may be warranted in the interests of safety, especially considering ice thrusts, for ice of great thickness forms here.

The gate-house, parapet wall, and gate-tower had a reinforcement of ¾ and ½-in. square twisted steel in all places where its need was evident. The item of structural steel is covered by railings, trash-rack, gate-house doors and shutters, and the spillway fittings. About 90½ tons

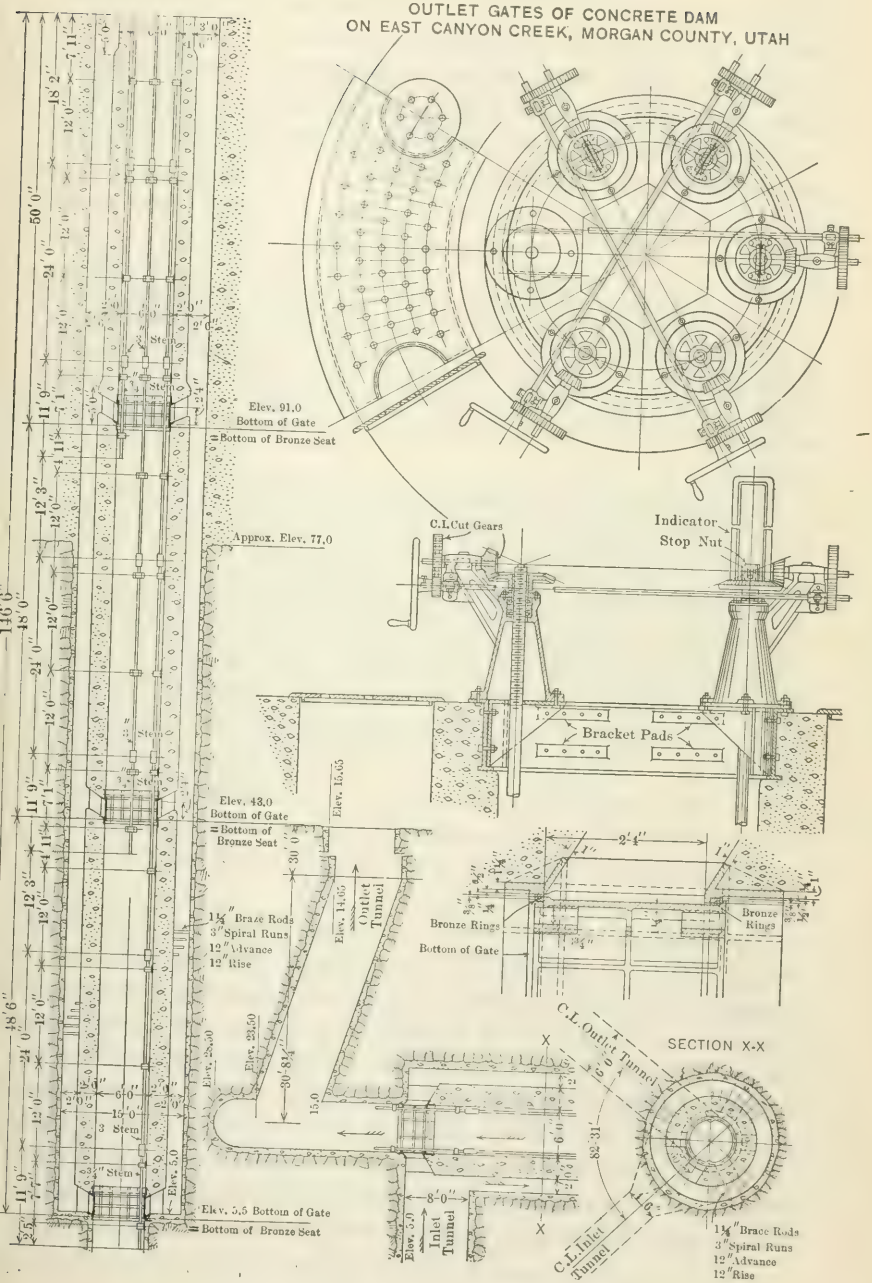

OUTLET GATES OF CONCRETE DAM
ON EAST CANYON CREEK, MORGAN COUNTY, UTAH
Elev. 91.0
Bottom of Gate
= Bottom of Bronze Seat
Approx. Elev. 77.0
C.L. Cut Gears
Indicator
Stop Nut
Bracket Pads
Elev. 15.65
Elev. 43.0
Bottom of Gate
= Bottom of
Bronze Seat
1¼" Brace Rods
3" Spiral Runs
12" Advance
12" Rise
Outlet Tunnel
Elev. 14.65
Bronze Rings
Bottom of Gate
Bronze Rings
SECTION X-X
C.L. Outlet Tunnel
C.L. Inlet Tunnel
1¼" Brace Rods
3" Spiral Runs
12" Advance
12" Rise
Elev. 5.5 Bottom of Gate
= Bottom of Bronze Seat
Inlet Tunnel
Elev. 5.0

FIG. 2.

of reinforcing steel were used. The greater part of this was in the arch, but a very considerable quantity was used in dowel pins, braces to the gate-tower crossing the surrounding space, as well as in the tower proper and about the gate-house, spillway, and thrust beams; no accurate segregation was made, as all was paid for at one price per pound, regardless of kind or place of use.

### The Outlet System.

The outlet system comprises an intake tunnel, a discharge tunnel, a vertical gate-tower in a shaft and carrying three balanced gates, set at the bottom of the tower and at the one-third and two-thirds points of the height, a sump or water cushion at the bottom of the gate-tower, and a hand-operated device in the gate-house for opening and closing the gates.

The concrete tower carrying the gates has an inside diameter of 6 ft.; the walls are 30 in. thick, and the outside diameter is 11 ft. This gate-tower is set in a shaft, 15 ft. in diameter, blasted out of solid rock up to about Elevation 70 and thence to the top forming a part of the north tangent. The annular space about the tower is always full of water, supplied through the intake tunnel; and, on opening a gate, discharge occurs into the 6-ft. opening in the tower, from which it drops to the sump and is discharged thence to the stream through the outlet tunnel. Leading from the reservoir to the annular space in the shaft about the gate-tower is the intake tunnel, 60 ft. long, with a cross-sectional area of 33.8 sq. ft., and with its bottom at the level of the bottom of the lower gate, at Elevation — 5, or 145 ft. below the top of the dam.

The outlet tunnel is also about 60 ft. long, and has a cross-sectional area of 50.2 sq. ft. It is set at a lower elevation than the inlet, and is arranged for a water cushion in the central shaft and a water seal for preventing a draft of air through the gate-tower, thus precluding the formation of ice. This is a matter of importance in this cold place. As it is necessary to draw all water through the old outlet system when the reservoir surface is below Elevation 100, the tunnels were designed to carry only the capacity of the old outlet. It would have been better, perhaps, to have made them larger, in order to avoid excessive velocities with the larger flows possible when the water is higher than the old dam.

### The Trash-Rack.

The old outlet had been provided with a light steel trash-rack, and, as it had given no trouble during 18 years of use, a similar rack of ½ by 5-in. steel bars, 5 in. from center to center, was placed at the new outlet. The rack rests on four pieces of 90-lb. rails, spanning the shorter way. When the water was drawn off, in the fall of 1917, it was found that trash which had gathered on the rack had reduced the flow of water until the resulting pressure had bent the steel rail supports and bent and twisted the rack bars. It is fortunate that the rack was not stronger; had it been equal to holding the pressure, a very embarrassing situation would have resulted. No indication of the condition was visible, and it was not suspected until the water was drawn off.

The bent and twisted rack was entirely removed, and the channel between the old and new outlets, about 5 by 5 ft., with an open top, was covered with a grill of pine poles having a minimum diameter of 9 in. These poles have an average length of 16 ft., and span the channel in an inclined position, extending from the outer side of the channel to the rock wall of the cliff on the other side, with clear spaces of 6 in. between the poles. The distance covered is 70 ft. The poles are fastened in place by setting 1-in. steel pins in the rock and using ties of No. 9 galvanized wire. This arrangement has not yet been tested, but promises good results.

### The Cylindrical Balanced Gates.

Each gate works in a cast-iron ring or cylinder set in the concrete walls of the gate-tower. Each cylinder has six 2 by 2-ft. openings in its perimeter, and these are symmetrically spaced. Freely movable vertically inside of the stationary rings are the gates proper, which are cast-iron cylinders with no openings. When the gates are fully down, the openings in the outer cylinders are closed. At the tops and bottoms of the cylinders are fitted heavy rings of naval bronze; when the inclined faces of the bronze come in contact, a water-tight joint is formed.

This arrangement insures a perfect balance of water pressures. Use has demonstrated that no more force is required to operate these gates under pressure from full heads of water than when there is no pressure. Hand-wheels are all that are needed for operation; the arrangement

provided for the purpose works very easily, and with such smoothness and speed as to call for nothing better; power operation would be of no advantage.

There are two stems, of $3\frac{3}{16}$-in. cold-rolled steel shafting, rigidly attached to opposite sides of each gate, extending up to the operating gears and below each gate, to form guides to steady them and assist in keeping them in position. The stems of the lower gates pass through holes in the castings of the upper gates, and all are provided with bronze-lined guides every 12.5 ft. in height. The top guides have feather keys, in order to prevent turning, and the bronze linings have a clearance of $\frac{1}{4}$ in. to allow for incrustations. The upper gates, when opened, discharge through the lower gates, and the small projections of stems and guides do not interfere with the discharge.

The tops of the stems are threaded with single square threads, three to the inch, working in heavy bronze nuts with thrust ball-bearings above and below the nuts. The hoists are arranged to operate the two stems of each gate at the same time by using one hand-wheel, having a gearing of cast iron with machine-cut teeth. The stands carrying the gearing are set on a heavy cast-iron ring with brackets, in such a manner as to leave a large opening at the top of the shaft for supplying air to overcome the strong suction caused by the discharging water. The need of this is shown by the fact that, when the gates are discharging, it is very difficult to open the steel door to the gate-house against the air pressure, notwithstanding the generous supply of air through the top ventilator on the gate-house provided for that purpose.

The wisdom of making the stems much heavier than called for by their computed tensile strength is shown by the accidental lodging of a 5-ft. length of 6 by 8-in. timber in the lower gate in some unaccountable manner. An attempt to close the gate showed that something was wrong, for before one man had nearly exerted his full strength on the hand-wheel, the heavy cast-iron top ring was started from its anchorage. When the reservoir was emptied, it was found that the timber was cut at least half way through. Lighter stems could not have withstood such abuse without being damaged.

### The Concrete.

The Red Devil brand of cement, manufactured at Devils Slide, Utah, was used throughout. The cement passed the tests satisfactorily.

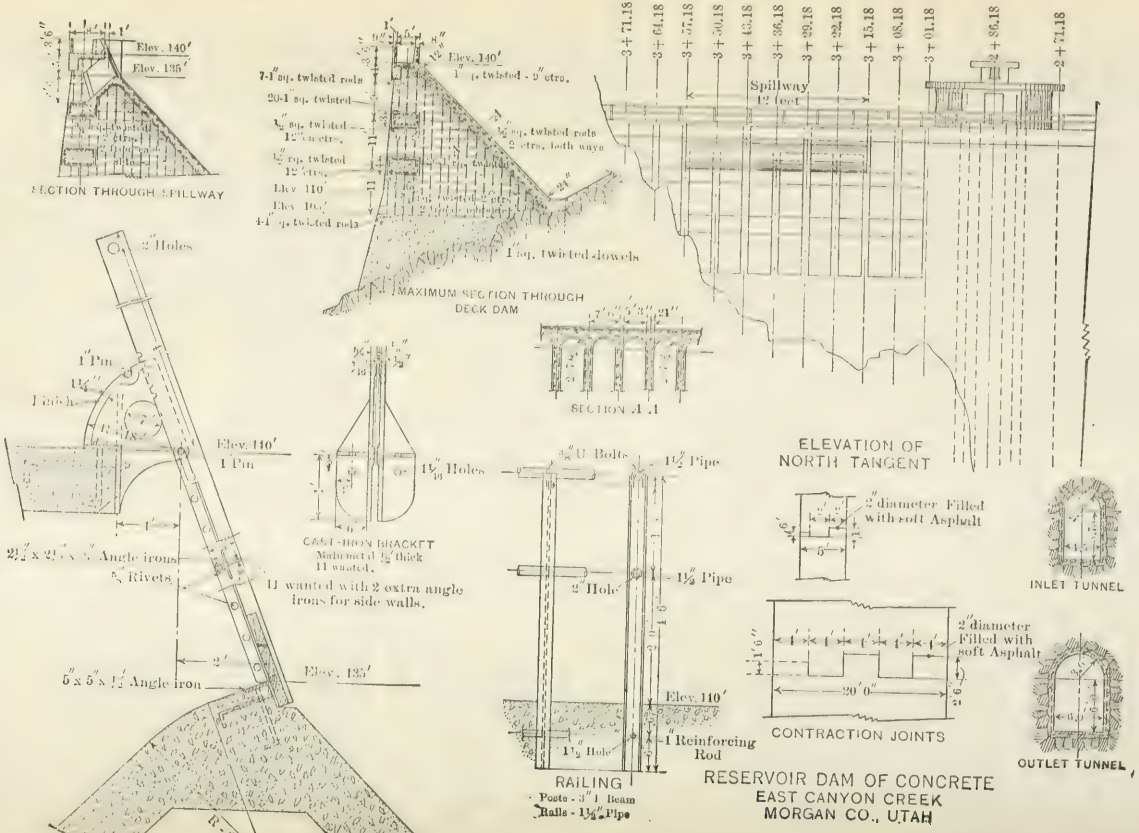

SECTION THROUGH SPILLWAY
Elev. 140′
Elev. 135′
MAXIMUM SECTION THROUGH DECK DAM
7-1″ sq. twisted rods
20-1″ sq. twisted
Elev. 110′
Elev. 100′
4-1″ sq. twisted rods
1″ sq. twisted dowels
SECTION A-A
Spillway 12 feet
3+71.18
3+64.18
3+57.18
3+50.18
3+43.18
3+36.18
3+29.18
3+22.18
3+15.18
3+08.18
3+01.18
2+86.18
2+71.18
ELEVATION OF NORTH TANGENT
2″ Holes
1″ Pin
1¼″ Holes
Elev. 110′
1 Pin
2½″ x 2½″ x ⅜″ Angle irons
⅝″ Rivets
11 wanted with 2 extra angle irons for side walls.
5″ x 5″ x ½″ Angle iron
Elev. 135′
R = 270′
CAST-IRON BRACKET
Malleable ½″ thick
11 wanted.
1¼″ Holes
⅝″ U Bolts
1½″ Pipe
2″ Hole
1½″ Pipe
Elev. 110′
1″ Reinforcing Rod
1½″ Hole
RAILING
Posts - 3″ I Beam
Rails - 1½″ Pipe
2″ diameter Filled with soft Asphalt
INLET TUNNEL
2″ diameter Filled with soft Asphalt
20′0″
CONTRACTION JOINTS
OUTLET TUNNEL
RESERVOIR DAM OF CONCRETE
EAST CANYON CREEK
MORGAN CO., UTAH

FIG. 3.

and it was unnecessary to reject any. A complete apparatus for testing cement and concrete materials was provided at the work, one man being constantly employed on tests.

The sand available had a very forbidding appearance, for it had a large content of fine silt and clay, and, when made into a cement mortar, presented a "muddy" consistency, but tests showed a fair strength and a good degree of water-tightness. Crushed rock was used for the coarse aggregate.

All the tests for strength were made by breaking mortar briquettes in a tensile testing machine. It is fully realized that such tests are properly only tests for cement combined with sand as mortar, and not true tests of concrete made with such mortar and under compression. The true test for concrete should be made in a compression machine of sufficient capacity to crush 8 or 10-in. cubes or cylinders made of the concrete used on the work, including the coarser aggregate. It is probable that the cost, large size, and weight of such compression machines is a bar to general use, as was the case in this instance.

Tests of mortar composed of the cement and sand showed a satisfactory increase in strength with age, some breaks in specimens of 1 cement to 3 sand running as high as 500 or 600 lb. per sq. in. at the age of 3 months.

Briquettes were made from the mortar from the mixer nearly every day concrete was placed. No breaks could be made at 2 days. At 7 days the tensile strength showed an average of about 100 lb.; at 28 days it was always more than double the strength at 7 days; and at 18 months the minimum was 310 lb. and the maximum 645 lb., with the average running about 500 lb. Breaks were made frequently between the 28-day and 18-month periods, and in no case was there a failure to show an increase of strength with time.

Notwithstanding the bad appearance of the sand, containing as it did much earth, clay, and silt, the outcome is very satisfactory, although more cement was used than would have been the case had clean sand been available. It is now known, however, that this concrete is more water-tight than if made with all screenings. All the concrete was mixed with more water than desired, in order to help in placing it in the forms and avoid the formation of rock pockets without mortar. It is well known that with fresh concrete, made with clean sand, the cement will be washed away by the least contact with water. Some concrete

in the foundation was placed in water without harm, or any loss of cement, and several times, when the pumps stopped, the surface of fresh concrete was flooded without bad effects, which would not have been the case with concrete made with clean sand.

The proportions of the concrete used in the body of the dam were, as nearly as possible: 1 part cement; 3 parts sand, with some screenings through a ¾-in. screen; and 5 parts broken rock, 3-in. maximum size.

In the body of the dam 4.75 sacks of cement per cu. yd. of concrete were used, and for about 800 cu. yd. about the gate-tower, for tunnel lining, and in the gate-house the quantity was 6.25 sacks per cu. yd. It was planned to use plum rock in the concrete of the dam body, but cold weather prevented, as it was too difficult to remove the snow, ice, and dirt from the rock.

### Concrete in Cold Weather.

Most of the sand was hauled early, and was in a large pile on the side-hill above the bins; and, becoming wet from the fall storms, froze to a depth of 2 or 3 ft. The broken rock was coated with frozen earth, snow, and ice. Notwithstanding the bins being roofed over, the materials often froze together. Nothing was done to overcome these conditions except to mix the concrete with hot water. The concrete as it came from the mixer was just above the freezing point, and, to maintain it at this temperature, it was necessary to keep the water hot and throw out the larger, solidly frozen lumps.

Experience soon showed that the rise of temperature due to chemical changes in setting prevented damage from frost when the concrete in the forms was covered at night. Canvas was spread over the forms, steam jets prevented surface freezing, and the temperature of the mass below the surface soon increased sufficiently to remove any frost occurring there, if not too great in quantity. The steam caused heavy deposits of frozen moisture on the forms; when this melted it caused a very sloppy condition, and so the steam jets were abandoned and salamanders burning coke were substituted, with an improvement of conditions. When concrete was placed on colder days the surface of the fresh concrete often immediately froze over to the depth of an inch or two. It was found that placing fresh concrete thickly over such a surface, quickly thawed it out without harm; but when the freezing was too severe, the frozen part was picked, broken up, and thrown out. Steam

jets were used freely to thaw out and remove the ice from the forms, concrete surfaces, and rock walls, immediately before placing concrete against them.

The removal of the 1½-in. pipes in the contraction joints afforded a very favorable means of testing the rise in temperature in the concrete when setting. Tests of temperature by lowering a thermometer into the holes showed in every case a considerable rise, a typical test showing a temperature of 70° Fahr. at a depth of 15 ft. when the air was at 14° Fahr., a difference of 56 degrees.

### The Forms.

The use of forms began at Elevation — 10. Up to that point the excavation was filled to the sheeting. The forms were built in sections 10 ft. high. At the top and bottom of each form 2 by 10-in. plates were placed, and vertical pieces of the same dimensions were set between as studs, 2 ft. from center to center, with 1 by 6-in. sheeting on the studs. At the jointing of the sections horizontal 2 by 6-in pieces were spiked to each stud, projecting 4 ft., with a 1 by 6-in. brace from below. These brackets formed a place for a working scaffold, and braces upward from the end helped to place the next section of forms.

When a form was filled to the top with concrete, and before it had set, 1-in. steel pins, 4 ft. long, with an eye at the top, were driven into the concrete, about 6 ft. in from the forms. Ties of 4-ply, No. 9 wire, were strung through the eyes in the pins and fastened to each stud at their one-third points of height, thus being inclined sharply upward. The wire ties were then twisted to tightness, and served to hold the forms true against the pressure of about 2 ft. of freshly deposited concrete; the concrete was accordingly placed in layers of about that thickness, moving back and forth as necessary to avoid excessive pressure and the resulting bulging of forms. No wires were allowed to reach from side to side of the dam. Where the thickness of the dam was greatest, two rows of anchor-pins were used, and only one row when the distance between the forms became less. Near the top, in the narrower space, the use of two rows was resumed, with the stay-wires crossing in order to keep proper distance from the forms; at the very thinnest part the wires were attached to the reinforcement. The forms about the gate-tower, spillway, and gate-house presented no special features, being of the usual 2 by 6-in. studs, 1-in. sheeting, and wire ties.

## The Plant.

The plant presented no unusual features, for it consisted only of ordinary steam-driven machinery, and was all adapted to use on this work from such as the contractors had left on hand from previous jobs. The excavation was dewatered by three 8-in., belt-driven, centrifugal pumps. Rock drilling was done by machine drills driven by compressed air. Compressed air was also used to drive some of the hoisting engines for the derricks. Rock crushing was done by medium-sized jaw crushers, and all materials were handled by gravity. Concrete was mixed in ¾-yd. Smith mixers, and conveyed by metal-lined chutes to steel mining cars running on a light track on top of the forms.

## Cost of the Work.

Table 1 is a detailed statement of the cost of the work, with quantities and unit prices.

TABLE 1.—Cost of the Work.

| | | | | | |
|---|---|---|---|---|---|
| Tunnel and Shaft Excavations: | | | | | |
| Neat section | 860.4 cu. yd. | @ | $5.40 | $4 646.16 | |
| Overbreak | 123.1 cu. yd. | @ | 2.16 | 265.90 | $4 912.06 |
| Foundation Excavation, above Elevation — 35: | | | | | |
| Neat section | 1 623.9 cu. yd. | @ | $2.50 | $4 059.75 | |
| Overbreak | 825.8 cu. yd. | @ | 1.00 | 825.80 | 4 885.55 |
| Foundation Excavation, below Elevation — 35: | | | | | |
| Neat section | 547.7 cu. yd. | @ | $5.00 | $2 738.50 | |
| Overbreak | 53.6 cu. yd. | @ | 2.00 | 107.20 | 2 845.70 |
| Hauling Cement: 19 170 bbl. @ 87½ cents | | | | | 16 773.75 |
| Reinforcing Steel: 181 200 lb. @ 3½ cents | | | | | 6 342.00 |
| Concrete: 15 888.38 cu. yd. @ $5.25, including forms | | | | | 83 414.00 |
| Cement: Furnished by the owners | | | | | 35 742.24 |
| Concrete Lining: tunnels and gate shaft, 590 sq. yd. @ $1.45 | | | | | 885.50 |
| Balanced Cylinder Gates | | | | | 6 250.00 |
| Sundry on Contract: Force account | | | | $8 713.70 | |
| Lumber left in excavation | | | | 450.00 | |
| Extra form work | | | | 500.00 | |
| Structural steel | | | | 938.98 | 10 602.68 |
| Inspectors on Concrete | | | | | 778.15 |
| Lands Purchased for Reservoir | | | | | 3 423.80 |
| New Road Around Reservoir | | | | | 5 278.60 |
| Total | | | | | $182 134.03 |
| Engineering, 6.15% | | | | | 11 217.24 |
| Total Cost | | | | | $193 351.27 |

The cost per acre-foot was $6.90. The cost of the concrete was $6.37 per cu. yd. The engineering cost covers all preliminary work from the beginning.

## Conclusion.

In the season of 1916 the water in the reservoir was raised only to the 100-ft. level, for the concrete work was too new to be put under full pressure. In 1917 the dam was full to the top, and a heavy flow wasted over the spillway. It is estimated that the water-shed furnished some 60 000 acre-ft. in that season. During the season of 1918 the entire yield of the water-shed only filled the reservoir to the 120-ft. contour. The dam has thus been fully tested. The gates have passed at times as much as 600 sec.-ft. without shock or jar. In the fall of 1917 the reservoir was completely emptied and the structure carefully inspected. Not a single crack or defect was visible; no sign of weakness, incipient disintegration, or scaling of concrete could be found. The sump was baled out, and it was found that the water in heavy flows falling from a height had not injured the concrete or rock in the slightest degree. The only thing found needing correction was the trash-rack, as already mentioned. When there is no water back of the dam, the contraction joints open about $\frac{3}{8}$ in., but, as the water rises, the joints gradually close tight.

Although resting on good, solid, water-tight rock, and joining it on the sides, there were several bedding places and cracks that threatened leaks around the dam. It was not attempted to stop these, because small leaks could do but little damage, beyond loss of water, and it was decided to try them out. As the reservoir was filled, and when the water was about 70 ft. in depth, two leaks appeared on the walls of the canyon, on the south side and about 75 and 125 ft., respectively, down stream from the dam. The combined flow of the two leaks is estimated at 2 sec-ft.; it is impractical to measure them. When the dam was first put under water pressure there was a heavy seepage or percolation through the concrete, heaviest at the horizontal joinings between concrete forms, but all rapidly reducing in quantity until the percolations were so small that they only showed when in the shade; when the sun shone on the surface it became dry. There was not one leak through the dam or its joining with the rock, nothing more than the percolations mentioned.

The seepage brought to the surface salts from the cement, and they cause a streaked efflorescence on the back of the dam; this is very plainly in evidence, and presents a false appearance of leaks that is very misleading, especially in a picture. That there are no leaks is shown by

the fact that when the gates were first closed, and until the appearance of the two small leaks mentioned, the flow of the creek was reduced so much that the Fish and Game Commissioner demanded that more water be admitted in order to keep the fish from being destroyed. Accordingly, a gate was opened a little.

When the dam was built it was necessary to leave a hole, 2 ft. square, through it at the lower gate level. This was stopped temporarily by a timber bulkhead. It is planned to place a 14-in. pipe in this opening, and, at the down-stream end, a heavy valve. The latter will be covered with a concrete house to guard against frost and meddlers.

As it is important to know the exact depth of water back of the dam, and its rate of rising or falling, a special device for this purpose has been designed. A heavy copper float, guided by two copper wires set vertically in the annular space about the gate-shaft, is suspended by a plated steel tape; the latter is wound on a 28-in. drum geared down by two reductions to the point where 50 ft. of movement of the tape will cause a movement of 1 ft. on the balancing weight. A wooden rule, 1 ft. long, is attached by the side of the tape to read the fractions of feet. It has not yet been tested, but promises to give good indications of small variations in depth, as this information is most important in the operation of the reservoir.

In spite of the unfavorable conditions of weather under which the dam was built, the fine clayey sand used, and the slight appearance of the arch, it may be pronounced a very successful structure. The contractors are entitled to credit for their faithful prosecution of the work under adverse conditions, and for their patience, courage, and fidelity to the interests of good work. The structure was not plastered or patched, but remained just as the forms left it, and with no deviation from true lines; no places show in the least careless or hasty work.

Credit is due to Samuel Fortier, M. Am. Soc. C. E., who, being familiar with the old dam and the conditions of the site, endorsed the building of the new structure. He also gave much valuable advice about its design.

The work was done by the Utah Construction Company, of Ogden, Utah, Mr. A. J. Sartons, of Washington, D. C., being directly in charge as Superintendent. Mr. H. F. Irwin was the writer's representative on the job.

AMERICAN SOCIETY OF CIVIL ENGINEERS
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# PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications.

## DETERMINATION OF THE DUTY OF WATER BY ANALYTICAL EXPERIMENT

### Discussion.*

By J. C. Stevens, M. Am. Soc. C. E.

Mr. Stevens.

J. C. Stevens,† M. Am. Soc. C. E. (by letter).‡—The writer begs the indulgence of the Society for a second discussion of Mr. Hammatt's paper. The first discussion‡ was written after a careful reading of the paper, but without analyzing the processes by which the author reached his conclusions.

Since that time, however, the writer has had occasion to inquire more deeply into the subject, and has also secured additional data, relative to the use of water on Chewaucan Marsh, which throw some extremely interesting sidelights on Mr. Hammatt's conclusions.

As these data are matters of public record, and appear in publications of the U. S. Geological Survey, the writer feels that there can be no breach of ethics in using them.

In his previous discussion the writer gave in Table 13§ the component parts of the duty as fixed by Mr. Hammatt. These component parts will be considered in the order in which they are treated by the author.

*Evaporation.*—The writer begs to call the author's attention to the results of a 6-year record of evaporation from a standard U. S. Geological Survey floating pan in the Klamath River, at Keno, Ore., 1904-1909.‖ This record was not used by the author.

After making some minor adjustments for missing winter records, the 6-year average evaporation and average monthly temperature given in Table 14 has been used by the writer.

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* Discussion of the paper by W. C. Hammatt, M. Am. Soc. C. E., continued from December, 1918, *Proceedings.*

† Portland, Ore.

‡ Received by the Secretary, February 24th, 1919.

§ *Proceedings,* Am. Soc. C. E., October, 1918, p. 977.

‖ *Water Supply Papers Nos. 177, 213, 251,* and *271,* U. S. Geological Survey.

Mr. Stevens.

TABLE 14.—MONTHLY EVAPORATION AND TEMPERATURE RECORD AT KENO, OREGON.

Average of 6 Years, 1904-09; Elevation, 4 090 Ft.

| Month. | Evaporation at Keno. | Air Temperature at Klamath Falls. |
|---|---|---|
| January | 0.50 | 32.0 |
| February | 0.60 | 35.6 |
| March | 1.09 | 38.0 |
| April | 3.13 | 46.4 |
| May | 4.14 | 49.9 |
| June | 5.16 | 57.4 |
| July | 6.44 | 69.2 |
| August | 6.46 | 66.1 |
| September | 4.65 | 59.2 |
| October | 2.26 | 50.0 |
| November | 1.07 | 40.0 |
| December | 0.80 | 30.8 |
| The year | 36.30 | 47.9 |

This record for 1909 is simultaneous with that at Ady used by the author; yet the evaporation at Keno was considerably less than that recorded at Ady. Moreover, the evaporation for the Ady station, as given by the author in Table 8, is not the Ady record.

The record for the Ady station for 1909 is given in "Working Data for Irrigation Engineers", by Moritz, whom the author quotes as his authority. Moritz takes his figures from Professor Bigelow's Abstract of Data No. 4 entitled "A Provisional Statement Regarding the Total Amount of Evaporation by Months at 23 Stations in the United States, 1909-10."

Table 15 is a comparison of the figures as given by Professor Bigelow and Mr. Moritz with those used by the author; also a comparison of the Ady and Keno records for 1909, with corresponding temperatures.

It appears from Table 15 that the evaporation from the Ady pan was 15.5 in. more than from the Keno pan. The reasons are apparent when the physical characteristics of the two exposures are compared.

Keno Pan.—3 ft. square, 18 in. deep, floating in Klamath River, a stream about 400 ft. wide; mean depth, 8 to 10 ft.; discharge, 1 000 to 3 000 sec-ft.

Ady Pan.—4 ft. diameter, 10 in. deep, floating in stagnant shallow water of a borrow-pit alongside of railroad embankment.

The water temperatures of the borrow-pit were much higher than those in Klamath River, which chiefly accounts for the increase in evaporation.

TABLE 15.—Comparison of Evaporation Records at Ady and Keno, Oregon, 1909. Mr. Stevens.

| Month. | Ady. | | Keno. | | | |
|---|---|---|---|---|---|---|
| | | | | Mean Temperature. | | |
| | Hammatt. | Bigelow (also Moritz). | Evaporation. | Water in pan. | Water in river. | Air at Klamath Falls. |
| January | 0.50 | 0.50* | 0 02 | 36 | 36 | 32.2 |
| February | 1.25 | 1.25* | 0.18 | 39 | 38 | 32.5 |
| March | 3.57 | 3.57 | 0.29 | 44 | 41 | 38.4 |
| April | 4.64 | 6.64 | 3.87 | 59 | 54 | 43.8 |
| May | 6.48 | 7.15 | 4.47 | 61 | 57 | 49.0 |
| June | 7.78 | 6.99 | 6.65 | 68 | 68 | 58.2 |
| July | 7.65 | 8.01 | 6.06 | 68 | 66 | 61.2 |
| August | 7.64 | 9.21 | 6.65 | 74 | 72 | 64.8 |
| September | 5.26 | 6.13 | 4.68 | 62 | 61 | 59.3 |
| October | 2.87 | 2.50 | 2.76 | 54 | 54 | 48.9 |
| November | 1.00 | 1.00 | 0.83 | 43 | 43 | 37 5 |
| December | 0.50 | 0.50* | ..... | ..... | ..... | 27.0 |
| The year | 49.14 | 53.45 | 38.0* | ..... | ..... | 46.1 |

* Estimated.

The results of experiments on evaporation at the Denver Laboratories by Mr. R. B. Sleight,* show that:

1.—Evaporation from flowing water is 8% greater than from still water, all other factors being equal.

2.—An increase in water temperature produces corresponding increases in evaporation, as follows:

2° increase in temperature produces 10% increase in evaporation.

4° increase in temperature produces 19% increase in evaporation.

6° increase in temperature produces 30% increase in evaporation.

10° increase in temperature produces 55% increase in evaporation.

16° increase in temperature produces 100% increase in evaporation.

The increase at Ady is 41%, which would be produced by a mean water temperature increase only 8° greater than that at Keno. The Ady record, however, was not used by the author in deducing the evaporation for Chewaucan Marsh.

It has been shown that the correct figures for evaporation at Ady are already 40% too high, yet the author increases them by 7½% for differ-

* *Journal of Agricultural Research*, July 30th, 1917.

Mr. Stevens.

ences in elevation, and then calls attention to the fact that they fit his figures deduced from Owens River, California.

Now examine the author's deduced evaporation for Chewaucan Marsh, in which a 4-year record from Owens River near Independence, Cal., was used. He first increases the evaporation at Independence by 16% for a corresponding difference in barometric pressure.

The author states "that evaporation at different elevations is in inverse proportion to the barometric pressure." He then gives the pressures at Independence and Chewaucan as 26.0 and 25.35 in., corresponding to elevations of 3 775 and 4 410 ft., respectively. Here is the equation:

$$\text{Evaporation at Elevation } 4\,410 = \text{Evaporation at } 3\,775 \times \frac{26.00}{25.35}.$$

This is an increase of 2½%, and not 16%, as stated by the author. The increase in elevation is 16.8%, which is probably what he had in mind.

In the paper cited by the author, "A Study of the Depth of Annual Evaporation from Lake Conchos, Mexico," by Messrs. Duryea and Haehl*, Subsidiary Conclusion (*e*) states their conclusions as to the relation between elevation, mean temperature, and evaporation, thus:

"(*e*)—In the Great Plateau Region, and at elevations above sea level of 600 to 5 000 ft. and monthly mean temperatures higher than 70° Fahr., the increases in the evaporation depth at any given mean temperature are directly proportional to increases in elevation; but at monthly mean temperatures lower than 70° Fahr., and at the lower elevations, the evaporation depth at any given mean temperature increases with the increase in elevation, but less rapidly than in direct proportion."

The writer positively denies that any such relation as that just quoted, or as modified by the author, has been established in the paper cited or elsewhere. A perusal of the paper in question and of the discussions which follow it will convince the most credulous that no such relation exists. As a matter of fact, such information as we have on the subject indicates the opposite tendency, namely, a decrease in evaporation with an increase in altitude.

An article by Samuel Fortier, M. Am. Soc. C. E.,† gives the results of experiments on Mt. Whitney, Cal., to determine the influence of altitude on evaporation. Evaporation records were obtained at stations varying in elevation from 4 500 to 14 500 ft.

Briefly stated, the results of this investigation indicated a consistent and steady decrease in the evaporation from the lower to the higher elevations, that at 10 000 ft. being 40% less than that at 4 500 ft. Professor Fortier concludes:

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* *Transactions*, Am. Soc. C. E., Vol. LXXX, p. 1829.

† "Evaporation Losses in Irrigation," *Engineering News*, September 19th, 1907.

"While these [non-uniformity of exposure] doubtless influenced the results to some extent it is safe to conclude that altitude was the controlling factor." Mr. Stevens.

It is the writer's belief, however, that the controlling influence, in the Mt. Whitney experiments and elsewhere, is water temperature, and that it is just as easy and just as logical to attempt to establish a relation between the water temperatures of Owens River and Chewaucan Marsh and their respective altitudes, as it is between the evaporation and elevation of the two places.

Moreover, if the evaporation varies inversely as the barometric pressure, it would be infinitely great in a vacuum, which is an absurdity.

After correcting the Owens Valley records for elevation, the author proceeds to correct them for mean monthly temperatures. This process can only be defended on the theory that air temperatures are some definite index of water temperatures. That there is a broad general relation between air and water temperatures is admitted, but when the great complexity of conditions, such as origin of water, *i. e.*, springs or surface-exposure, depth, currents, atmospheric conditions, etc., are considered, the relation must necessarily be so broad and general that the author's use of it cannot be defended on any logical basis.

By way of illustration, it is interesting to note the effect on evaporation and plant transpiration of the volcanic eruption of Mt. Katmai, Alaska, during the early part of June, 1912. This effect was noted by Messrs. Briggs and Shantz during their experiments to determine the water requirements of plants at Akron, Colo.*

These gentlemen increased the water consumption of plants during 1912, as observed by them, 30% in determining mean values from the 3-year record, 1911, 1912, and 1913. They also show that evaporation from a free water surface during June, July, and August, 1912, was 22% lower than the average of 1911 and 1913. These reductions in both evaporation and plant transpiration were charged directly, by them, to the volcanic disturbance cited.

When such remote causes are seen to exert such powerful influences, it would seem that the results obtained by the author are absurd. He increases the Owens Valley records 16% for elevation (our present knowledge indicates they should be reduced, if corrected at all); next, he reduces them for temperature (with no basis of fact); then he increases them 33% for shallow water (an utterly unfounded assumption); finally, he decreases them by varying quantities for plant growth (purely guesswork); and he confidently states that the mean evaporation on Chewaucan Marsh, from March 15th to June 30th is 10.51 in.

*Transpiration.*—The author states that the mean daily rate of transpiration on Chewaucan Marsh was 198% of the green weight of sugar

* "The Water Requirement of Plants," *Journal of Agricultural Research,* October 15th, 1914, by Lyman J. Briggs and H. L. Shantz.

Mr. Stevens.

grass on June 27th, which was the 105th day of its growth, and that the plant was fully grown. Is there any reason to assume that the plant stops transpiring water at maturity? It would be just as logical to say that man did not require food and water after he was fully grown. Certainly, transpiration continues until the crop is harvested, which, the writer infers from Figs. 15 to 20, and elsewhere in the paper, is not done until some time in August.

The determination of the 198% is based on 15-min. weighings during 10 hours of a single day in the season. The remainder of the 24 was determined by guess. The weight of green matter was "considered" to increase uniformly during its period of growth. The author states that:

"Although the experiments seemed to show that the rate of loss immediately after cutting was from 40 to 50% greater than after a period of 15 min. * * *"

this was ignored. Yet the whole process is founded on the theory that the rate of transpiration immediately after cutting is a measure of the rate during growth.

Furthermore, the diagram, Fig. 10, indicates that the so-called cured hay was still losing moisture at the rate of 10% per day. Surely his average crop of 2½ tons per acre is not based on a 3-day's curing. Hay is not usually measured for crop statistics until after 30 days or more in the stack. If measured in this way, it may lose as much as 80% of its green weight.

Cured hay was found to contain 40% of moisture. Hence, it is found that in Chewaucan Marsh the transpiration ratio for green hay was 30% of that of cured hay, and that of cured hay was 60% of that of dry matter.

Now examine the transpiration figures for the Harney Valley, given in each of the diagrams Figs. 15 to 20, inclusive. The results are given in Table 16.

TABLE 16.

| Crop. | Transpiration Ratio to: | | |
|---|---|---|---|
| | Green weight. | Cured hay. | Dry matter. |
| Fig. 15—Sugar and mixed grasses | 123 | 409 | 682 |
| " 16—Mixed grasses | 73 | 242 | 403 |
| " 17—Sugar grass | 164 | 597 | 912 |
| " 18—Sugar and mixed grasses | 122 | 402 | 669 |
| " 19—Mixed grasses | 71 | 238 | 398 |
| " 20—Sugar grass | 104 | 346 | 577 |

The figures in Table 16 show that, with the exception of Fig. 17, the ratio for green weight is 30% of that of cured hay, and that of cured hay is 60% of that of dry matter. In other words, the cuttings from the several pans were neither cured nor dried. Instead, the green cut-

tings were weighed, then a factor, determined on Chewaucan Marsh, 100 miles away, on a bright day in June, was used to find the transpiration ratio for different varieties of grasses in the Harney Valley, and the results were given to the Engineering Profession as scientific data. Mr. Stevens.

As the author does not give his figures for plant use, in inches, the writer had to do some guessing. He "guessed" that the author's figures for the transpiration ratio of dry matter more nearly represented that of cured hay, and that the plants transpired water until harvested. The average of the author's ratios for dry matter for the Harney Valley was 600:1, and the writer "guessed" that 650:1 would be about right for Chewaucan Marsh. In this manner the 8 in. and 14½ in. for Harney and Chewaucan, respectively, given at the beginning of this discussion were found.

*Soil Absorption.*—The writer wishes to protest against the misconstruction placed on the results obtained by Charles H. Lee, Assoc. M. Am. Soc. C. E., as shown by the following quotation from the author:

"From the writer's previous work in soils of a similar nature, it was found that, with ground-water at a depth of about 8 ft., soil evaporation would be negligible, and, for any depth to ground-water of less than 8 ft., the quantity of evaporation would be proportional to the depth. A similar conclusion was reached by Mr. Lee in his work previously cited."

Mr. Lee's experiments were made in order to determine the soil evaporation from the floor of the Owens River Valley, and that evaporation includes transpiration of the native salt grass. His results give the soil losses from the sandy clay loam soils, but Mr. Hammatt has applied them to peat.

Now, there are peats and peats. The 25th Annual Report of the Vermont Agricultural Experiment Station, 1911-12, contained the following data:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Turfy peat | weighing | 7-16 | lb. | per. | cu. | ft., | air-dried. |
| Fibrous | " | " | 15-42 | " | " | " | " | " |
| Earthy | " | " | 25-56 | " | " | " | " | " |
| Pitchy | " | " | 38-65 | " | " | " | " | " |

The author gives the saturation content of peat soil as 274% by weight, of which 253% is free moisture. He also states that the Chewaucan peat soil had 58% voids. These figures give a weight of 14.3 lb. per cu. ft. of air-dried soil, which indicates that the Chewaucan soil would probably fall under the "Turfy peat" classification. The writer's general knowledge leads him to believe this peat is of a coarse, rooty structure, with a large capacity for water, but with low capillary properties compared with the clay loams. If this is true, the height to which water will rise by capillarity is very limited indeed.

The limit of the rise of water by capillarity in certain soils is given in Table 17.*

* As given by Professor Hilgard, in 'Soils," The Macmillan Company.

Mr. Stevens.

TABLE 17.

| Soil. | Limit of rise. | Time required. |
|---|---|---|
| Sandy soil, Stanislaus County, Cal. | 17 in. | 6 days |
| Gila River alluvial soil. | 47 " | 125 " |
| Silt soil, Ventura, Cal. | 50 " | 195 " |
| Adobe soil, Alameda County, Cal. | 46 " | 195 " |

The writer has seen no similar data for peat soil, but it is very doubtful if water will rise by capillarity more than 2 or 3 ft. When the ground-water falls below the limit of capillary rise, soil evaporation ceases.

On the assumption that the limit of capillary rise in peat soil is 30 in., instead of 96 in., it appears that the author's quantity of sub-soil evaporation, as indicated in Table 12, is 50% too high.

The writer is unable to understand Fig. 23. Apparently, 13½ in. of water were put in the tube on September 11th. Thereafter, at stated intervals, the recession of water in the tube, or the depth to ground-water, was measured. Apparently, at the close of the experiment, the soil had absorbed 10.5 in. of water, which resulted in lowering the ground-water 18 in. In other words, the porosity of the unwatered soil in the tube was 58 per cent. Were the dotted lines merely drawn to confirm the previous determination? Does the diagram really show anything more?

*Quantity of Water Actually Consumed on Chewaucan Marsh.*—The quantity of water actually consumed is the crux of the whole matter. If the author's processes are logical, his deductions as to the water consumption should conform to the actual consumption, as indicated by the difference in flow at the upper and lower ends of the marsh. The writer has stated* that:

"This consumption should be comparable with the sum of the first three component parts of the water duty previously given, and, in the writer's belief, will be considerably less than the 37.2 in. which the author's analysis seems to indicate as the required quantity."

Since that was written, Water Supply Paper No. 410 has come to hand, and it gives the results of stream measurements in the Chewaucan River Valley for the seasons of 1914 and 1915. The writer has also secured the unpublished results for 1916 and 1917, which may be had by any one on application to the Director of the U. S. Geological Survey, Washington, D. C.

The map, Fig. 1, should be consulted in order to understand the situation properly.

* *Proceedings*, Am. Soc. C. E., October, 1918, p. 978.

Mr. Stevens.

Three gauging stations were maintained on Chewaucan River:

1.—The Paisley Station, which is above all important irrigation diversions, 2½ miles up stream from the Town of Paisley;

2.—The Narrows Station, at the constricted portion of the marsh; and

3.—The Hotchkiss Ford Station, just below the marsh.

The following stations were also maintained at the diversion points of ditches watering the alluvial fan at the head of the marsh:

Conn Ditch, irrigating 600 acres;

Smalls Creek, irrigating 2 417 acres, including 1 209 acres under the Bageley Ditch;

Jones-Innis-ZX Ditch, irrigating 2 118 acres.

There are 14 300 acres of marsh and about 6 200 acres of upland watered between the Paisley and the Narrows Stations, of which 5 235 acres are accounted for by the ditches just mentioned. There are also 7 800 acres of marsh between the Narrows and Hotchkiss Ford Stations.

In order to determine the quantity of water consumed on the marsh, it is necessary to deduct a portion which is diverted to irrigate the uplands. A considerable portion of the diverted water finds its way by percolation and waste to the marsh.

In Table 18 only 40% of the water diverted has been considered as consumed; the remaining 60% being returned to the marsh. The diversions for the 965 acres unaccounted for have been neglected. This gives the consumption on the marsh the benefit of all doubt.

The period of consumption, given by the author, March 16th to June 30th, inclusive, has been used.

TABLE 18.—Water Consumption on Chewaucan Marsh.

| | March 16th to June 30th, Inclusive. | | | | |
|---|---|---|---|---|---|
| | 1914 | 1915 | 1916 | 1917 | Average. |
| Flow at Paisley, in acre-feet | 94 600 | 39 510 | 77 200 | 93 640 | 76 240 |
| Deduct for consumption on 5 235 acres of upland —40% of measured diversions | 8 000* | 7 900 | 8 200 | 7 600 | |
| Net flow to marsh | 86 600 | 31 610 | 69 000 | 86 040 | |
| Flow at Narrows, in acre-feet | 70 800 | 11 260 | 43 200 | 64 180 | |
| Consumed on 14 300 acres of marsh | 15 800 | 20 350 | 25 800 | 21 860 | |
| Depth, in feet | 1.10 | 1.42 | 1.80 | 1.52 | 1.46 |
| Flow at Hotchkiss Ford, in acre-feet | 59 250 | 2 160 | 31 360 | 51 180 | |
| Consumed on 7 800 acres of marsh | 11 550 | 9 100 | 11 840 | 13 000 | |
| Depth, in feet | 1.48 | 1.16 | 1.52 | 1.67 | 1.46 |
| Consumed on 22 100 acres of marsh | 27 350 | 29 450 | 37 640 | 34 860 | |
| Depth, in feet | 1.23 | 1.33 | 1.70 | 1.57 | 1.46 |

* Records incomplete—estimated.

Mr. Stevens.

The period of record includes two years of abundant supply, 1914 and 1917, and also one low year, 1915. The consumption during 1916, when the author's investigations were made, is seen to be the highest of record, although the water supply was about the average. The supposition is, therefore, that the crop conditions during the period of his investigation were somewhat better than the average. If this is not true, the conclusion is inevitable that the hay lands received too much water. At all events, it is obvious that the crops received all the water that was necessary for their growth.

Before making a comparison of the author's computed requirements and the water actually consumed, it is only just to reduce the quantity for plant consumption previously given by the writer, to that represented by the author's deduced transpiration ratio of 347 lb. of water per pound of cured hay. Making this correction, the requirements as computed by the author are:

| | Chewaucan Marsh. |
|---|---|
| 1. Soil moisture | 12.17 in. |
| 2. Soil evaporation | 10.51 " |
| 3. Plant use | 7.64 " |
| 4. Soil losses | 23.00 " |
| Total depth | 53.32 in. = 4.44 ft. |

Now the first three of these items should be comparable with the measured consumption, if the author's hypotheses and deductions are rational. That they are not, is evident from the following:

| | Author's deduced requirement. | Actual measured consumption. |
|---|---|---|
| Water consumption on 22 100 acres of marsh for soil moisture, soil evaporation, and plant use, in feet | 2.53 | 1.46 |
| Error | 73% | .... |

The author's Item 4, "Soil Losses," is treated under the caption, "Percolation and Run-off." He states that there is no percolation, but that the marsh hay will not thrive unless the ground is completely covered with running water during the period of growth, and further fixed the necessary quantity as 23 in. of depth.

The actual run-off from the 22 100 acres of marsh is that measured at Hotchkiss Ford, as given in Table 19.

It is inconceivable that all the run-off is necessary. If this were true, there could scarcely have been any crop at all in 1915, as the run-off was only 1 in. Furthermore, during 1916, while the investigations were under way, it is seen that the author's requirement is 35% greater than the total supply available for this purpose. Little more

need be said. The actual figures refute the author's processes and conclusions. Mr. Stevens.

TABLE 19.—RUN-OFF AT HOTCHKISS FORD, FROM MARCH 16TH TO JUNE 30TH, INCLUSIVE.

| | Acre-feet | Depth, in feet. |
|---|---|---|
| 1914 | 59 250 | 2.67 |
| 1915 | 2 160 | 0.10 |
| 1916 | 31 360 | 1.42 |
| 1917 | 51 180 | 2.31 |
| Average | | 1.62 |

AMERICAN SOCIETY OF CIVIL ENGINEERS
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# PAPERS AND DISCUSSIONS

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## THE NATIONAL RAILROAD QUESTION OF TO-DAY.

### Discussion.*

By Messrs. T. Kennard Thomson, A. J. County, George W. Kittredge, Calvin Tomkins, Augustus Smith, John H. Bernhard, George J. Ray, and Herbert C. Keith.

Mr. Thomson.

T. Kennard Thomson,† M. Am. Soc. C. E.—This is the most valuable paper the speaker has ever heard presented to this Society; its very brevity enhances its value.

The speaker is tempted to enter a lengthy discussion, but, for the sake of emphasis, will only mention two points, and those briefly.

Standard designs are all right in certain cases, that is, when the design is as nearly perfect as it can be made, and when used in the right place only. An old engineer once said: "A standard design is a stand-still design," and probably the most glaring offense in this line ever perpetrated on the public is the (can't sit still) design of the parlor car chair. The speaker has yet to find any one who was made to fit this uncomfortable seat.

As for Government ownership of railroads, the "proof of the pudding is in the eating thereof." It is known that the rates charged by the Government-owned railroads of Germany and elsewhere are much higher than in the United States, in spite of the shorter haul.

To come nearer home: Canada affords a very good comparison, for the Canadian Government spent $100 000 a mile to build the Transcontinental, and the Canadian Northern built an equally good road for $50 000 a mile.

* This discussion (of the paper by Francis Lee Stuart, M. Am. Soc. C. E., published in February, 1919, *Proceedings*, and presented at the meeting of February 5th, 1919), is printed in *Proceedings* in order that the views expressed may be brought before all members for further discussion.

† New York City.

Mr. Thomson.

Again: The Canadian Pacific Railroad spends $70 for interest and other charges to earn $100, and the Canadian Government spends from $200 to $220 for the same purpose.*

In other words, the Canadian Go ernment spends twice as much to build and three times as much to operate as the privately owned railroads.

This is Government ownership as it was, is, and always will be.

Mr. County.

A. J. County,† M. Am. Soc. C. E.—The railroad situation has this gratifying feature: It demands thorough consideration, and, as the solution of the problem affects all citizens, the most experienced men should express their views freely. The speaker has listened with interest to many of the plans suggested to the Senate Committee in Washington, and congratulates Mr. Stuart on having "thrown into the ring" another plan which has so many sane features, and aims to preserve initiative and development in the transportation industry.

*Should We Have Five More Years of Federal Control?*—The situation impresses the speaker like this: The railroads have had Federal control and operation since January 1st, 1918, and, by Act of Congress, that control can continue for 21 months from the Declaration of Peace. The country is requested to endorse 5 years more of such control and operation. That means uncertainty, with consequent disruption of the experienced managements and organization, and it would be politically unwise and economically unsound for us to continue in peace the form of operation and control that the war period necessitated. There appears to be nothing to prevent the return of the properties to their experienced managements and officers to operate the same for the Government during the 21 months that will follow the Declaration of Peace. That allows sufficient time to adjust the situation, permits the Government to fund loans made to the railroads, give them a final settlement of compensation due for the use of their properties, including deferred maintenance of roadbed and equipment, caused by lack of men and materials in the war period, and for Congress to adopt a constructive railroad policy for the future.

*What Future Policy Should be Adopted?*—As to such future relations between the railroads, the Government, and the public, we must have an open mind. Happily for us, the world has had experience on all plans suggested, so that we are not left to much guesswork or assumption in reaching a proper conclusion. There must be determined which one of the three chief suggested policies should be adopted as best for the welfare of the country and its interests here and abroad to produce the best and cheapest transportation service, viz:

1. Government ownership and operation, and financing.

* Much valuable information about Canadian railroads may be found in a paper by W. F. Tye, M. Am. Soc. C. E., *Transactions*, Can. Soc. C. E., January-June, 1917.

† Philadelphia, Pa.

2. A regional guaranty plan by which the individual railroads are to be amalgamated and operated by about a dozen regional non-competitive companies, and the present railroad securities exchanged on some basis for Governmental guaranteed securities of the regional companies, the Government to provide future capital. Mr. County.
3. Private operation, under strict Government regulation, by the existing railroad companies, with competition in service and effort to serve the public; the ownership of said companies to continue to be vested in our citizens and in their savings, industrial, and other institutions, and the citizens to provide future additional capital for railroad expansion.

*Government Ownership and Operation Opposed.*—We can at the moment say definitely that Government ownership and operation will not meet with public approval, although its advocates are by no means asleep. The experience of the world is against it, as a sound political and economic method. A nation may favor it for military purposes, or for some special national emergency or purpose, just as our own country assisted the construction of the railroads to the Pacific Coast and in Alaska, and many of our States constructed railroads and other public transportation facilities in the past, but it is opposed to our forms of progressive democratic institutions as a whole, and the activities and temperament of our citizens.

*Should Regional Railroads and a Government Guaranty Plan be Adopted?*—Therefore, we must consider the second suggestion, that of one dozen Federal regional companies, owning and operating under Governmental guaranties. The argument for regional companies under a guaranty generally proceeds along these lines: Just as the Federal Reserve System mobilized and protected the resources of the banks, so the resources of the railroads can be mobilized and their operations unified. Such a statement ignores the fundamental framework of the Federal Reserve Law.

*Federal Reserve Regulation Compared with Railroad Regulation.*—It produced an admirable system of financial responsibility and cooperative effort, but do not forget that individual banks were left untrammeled (so long as they observed honest and business-like banking methods) to make as much or as little money as they chose for their owners and to strengthen their reserves. That left private ownership and initiative of each bank free to act within the limits of the law and good management. Consequently, the banks have been the bulwark of the country in the hour of its financial stress. No argument is used that the interest rates which allow the little bank to exist make the big bank too rich at the expense of industry or the public. We realize that the strong bank is better able to serve the

Mr. County.

Nation, and that its profits are ultimately regulated by taxation and the stress of financial depressions or losses, the same as railroad rates and profits are regulated. Banking, like railroading, affects every citizen and every industry, yet we are proud of our strong banks—why not of our strong railroads? The railroads have regulation that corresponds to the Federal Reserve Board and the Federal Reserve Banks, in the Interstate Commerce Commission and the State Commissions. The serious difference lies in this fact: the country enacted constructive banking laws, but punitive railroad laws. The Federal Reserve Board and the Federal Reserve Banks are required to be constituted so that they cannot become purely political institutions. The Boards are required to be directed by representatives of banking, commerce, agricultural, or other industrial pursuits, in addition to representatives of the Government, and, in the case of the Federal Reserve Banks, stockholders are also represented; but, in the State and Federal Commissions regulating the railroads, no such constructive provision has been made.

Further, in the railroad regulation we already have Regions, with the States as boundaries, for the State Commissions; and, for the Interstate Commerce Commission, rates are not dealt with for the entire country, but in the various traffic regions; and we have railroad systems, competitive in service and with the necessity to earn profits. Therefore, theoretically, we have enough machinery for railroad regulation now existing, largely similar to that of the banks; but we need the mandate of constructive railroad laws; we need the concentration of responsibility for railroad results and credit; and we need to add to our railroad regulatory bodies, now exclusively political, experienced men representing the activities of the country in industry, commerce, and agriculture, men who should be strong enough to enforce a National policy to insure the development of the transportation facilities and the credit of the railroads. First give the railroads constructive laws, and commissions, representing the country at large, responsible to enforce those laws.

Further, the suggestion of non-competitive regional guaranteed railroads, though it might produce some more co-operation, wipes out the element of competition in service and in endeavor to serve the public. We already have competitive regional systems, like the New York Central and the Pennsylvania Systems, that include hundreds of smaller companies, and more can be done when there is an earning basis to justify it. These regional systems preserve initiative and develop the country, but the regional railroad plan would unify all the railroads in that region, and would have no such incentive. There is nothing in the railroad situation to prevent further unification of the various railroad systems and their feeders, provided proper legislation is passed. Take the Pennsylvania Railroad: There are still

about 140 active companies in that system, but they represent what were originally more than 600 companies. There has been a gradual evolution toward big systems which are competitive in service and in management. That is the healthy thing for the country, but our restrictive State and Federal laws stopped the process. Mr. County.

*Should we Have a Government Guaranty?*—As to the Government guaranty: This regional plan and Government guaranty is practically the French plan. Under a Government guaranty there would be no inducement to take further risks. Here is a serious element against which the commercial interests of our country must guard or we will have stagnation. The speaker can do no better than refer to the testimony of the English economist and lawyer, Mr. Acworth, before the Senate Committee, in May, 1917, amplified by quotations from the eminent French economist, M. Leroy-Beaulieu, which will be added to this discussion. We need not go so far for results of the guaranty plan. In various parts of our own continent the regional guaranty plan has been tried. The Federal Government has tried it for 1918 with regional operations and a guaranteed standard return. As the railroads earned a good excess over that return under private operation, it was felt that the Government, with all restrictive laws and commissions eliminated, would earn substantial profits over its guaranty. The results for the three years ending June 30th, 1917, justified the standard compensation, which was equivalent to only about 5.2% on the road and equipment investment of the railroads. Just the same, whether we attribute it to war or other conditions in which economic results necessarily had to be overlooked, whether we say it is due to inefficiency or the great increase in the number of men and women employed, or the concentration of management from the local field to Washington, or the change from the trained managements, with private initiative and enterprise, to the regional plan, it produced a deficit, and we have not yet had the final figures. With all that, the speaker is willing to admit that the experiment justified the cost, considering the conditions confronting the country. The experience of Canada regarding the railroad guaranty will bear some careful reading. We know it is far from economic, and we know that the taxpayers will have to meet the huge loss. We have heard of the new era of "transportation for cost" on the Boston Rapid Transit lines, and the result will be an 8-cent or probably a 10-cent fare, or public taxation must meet the deficit. Indeed, we need not go outside of New York City to see what municipal ownership of the subways and the guaranty plan can produce. We know, fundamentally, that when a guaranty is given we take the first steps toward Government ownership, because the guarantor must assume the financial responsibility covered by its guaranty, and must also become finally responsible

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for the yearly capital improvements and financial budget, as well as for the final operating and maintenance results and service standards. Think of what it means in a country like ours, with changing political conditions and policies, and no party permanently responsible for the results.

Further, many of the advocates of the regional railroad guaranty plan require the practical financial reorganization of all the railroads in the country, the basis for which must be largely by capitalizing past net earnings or waiting for a final valuation, and, on the result, exchange existing bonds and stocks for those of the regional railroad companies. If any one can foresee the end of such a policy in a 10-year period, he is certainly optimistic. With present conditions, and with the load of war financing on the country, why add this additional load?

*What Would Such a Government Guaranty Cost the Investor?*—The railroad investor will first have to stand the results of such a financial reorganization and re-valuation of his property, and he must pay for the security of a Government guaranty. The general experience under the administration of such laws as the Railroad Valuation Law and the Federal Control Law is that they are slow and vexatious, and not by any means interpreted in a broad spirit, no matter what may have been the purpose of the framers. The investor, therefore, is bound to be sacrificed at the outset, and, in addition, under Federal guaranty and regional non-competitive operation, he, as a taxpayer, will have to share in the higher expense of conducting railroad operations when they are freed from the competition that exists under private initiative and management. He is held out the hope of a minimum guaranty and a share in the future profits. What Governmental body will allow the rates to exist to earn profits over the minimum guaranty? What commercial organizations would insist that rates should be increased for that purpose? The disturbing feature is that our advocates of Government ownership, or of Government guaranty, probably feel that it is no longer possible, under our laws, or through our Courts, to retain private initiative and ownership and yet secure a just return to railroad owners on their investment, so that there can be no safety to the investor except by putting the burden on the country at large. If we have reached that state with regard to a railroad investment of $20 000 000 000 that affects the entire country, we are no longer safe, even under a Government guaranty, in holding any railroad securities. Under such a state of mind, where will our country stand in getting its share of the world's business, and carrying it at the lowest rates? There are other suggestions as to guaranty, but the plan generally urged requires regional companies to unify the railroads regionally as described, believing that such non-competitive unifications will realize savings, and they will be disappointed.

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*Railroad Executives' Plan—Private Ownership and Operation.*—To guard against the two extremes of this situation, viz: Government ownership and operation, and non-competitive regional Government guaranty companies, the Association of Railway Executives produced a plan, published prior to any other, based on their experience and continued study of several years, recommending continued public ownership by our citizens and their institutions, with private initiative and management, under strict but responsible Governmental regulation, with the ability to co-operate with each other, free from restrictive laws. It avoids political management, operation, and financing. That system, notwithstanding all criticisms, has in the past produced railroads giving the best and cheapest transportation, as a whole, of any system in the world, has the lowest capitalized cost, and has paid the highest wages and the highest taxes in the world.

*Exclusive National Regulation.*—Their plan calls for the exclusive National regulation of rates, of interstate commerce instrumentalities, railroad security issues, and important capital improvements. It provides for the separation of the judicial from the administrative functions of the Interstate Commerce Commission.

*Interstate Commerce Commission a Judicial Body.*—It constitutes the Commission as the judicial body to pass upon the reasonableness and adequacy of rates, with power to prevent all discriminations in rates or service, and to supervise railroad accounting and valuation.

*Regional Commissions.*—The Commission is assisted by regional commissioners, convenient to the public in their several States, with power, subject to the Interstate Commerce Commission, to deal with regional transportation questions and rates in their territory, and can recommend betterments of the transportation service and facilities.

*State Commissions.*—The State Commissions would continue their regulation of intrastate questions and corporations, which have become such a large feature in our daily life, such as trolley companies, electric light, gas, water, heat, power, and sewerage companies, and other features.

*Administrative Department of Transportation.*—The plan further recommends the creation of a Department of Transportation under a cabinet officer called the "Secretary of Transportation," so as to concentrate the responsibility on the National Administration for adequate transportation service and facilities for the country; to protect the just interest of the owners and employees, as well as of the shippers and the traveling public; to deal with administrative questions, such as traffic distribution, joint use of terminals, proper car supply, and other railroad administrative and executive functions, so that promptness and the responsibility of the National Government would be continually back of the railroads. This officer, however, would not have the powers of the present Director General. He would not operate the

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railroads, nor appoint any of the officers or employees, and therefore no unavoidable hurtful political influence could be exercised by him, any more than has been exercised in connection with the appointment, removals, and other features of the State and Interstate Commissions. Let us not delude ourselves that politics will be absent from railroad questions in our democracy. Let us, therefore, make it the most responsible political influence on which the eye of the public is continually directed, instead of scattering the responsibility for railroad results over 48 States and Commissions. The speaker has little doubt that if the public preferred a small National Railroad Board headed by the Secretary of Transportation, but including representatives of business pursuits like commerce, industry, agriculture, finance, or railroading, to deal forcefully with railroad administrative questions, like the Federal Reserve Board, there could be no reasonable objection, but the Secretary of Transportation must be responsible to the President and the country.

The Railroad Executives' plan provides for the funding by the Government of the loans to the railroads during the period of Federal control.

*Railroad Consolidation and Co-operation.*—It also recommends further amendments of the restrictive Federal and State laws to enable the railroads to co-operate with each other to provide joint facilities for public convenience, and to enable the carriers to acquire feeding and connecting systems, and, to carry out more satisfactorily these beneficial forms, that Federal incorporation of the interstate carriers be permitted.

*Rate Making.*—The plan recommends that carriers have the power to initiate adequate rates, subject always to the approval of the Secretary of Transportation, and to final public review by the Interstate Commerce Commission as a judicial body, but rate initiation, suspension, and final disposition must be effected within 90 days, in lieu of the seemingly interminable periods in the past that so unsettled business and disrupted the railroads.

*Statutory Rule to Fix Adequate Rates.*—The final features of the Governmental control recommended by the Railroad Executives is a Federal law which shall include a statutory rule for making reasonable and adequate rates. If that power had been, or could have been, exercised in the past, there would have been no railroad problem, because the revenues would have been sufficient to offset rising costs and taxes, and attract the capital necessary to meet the railroad needs, and provide a basis to enable well established companies to sell stock as well as bonds on reasonable terms, and so prevented a great increase in the mortgage and fixed debt of the railroads. This rate-making rule has always been regarded as a difficult thing to lay down, because of changing conditions, and yet, in the decision of the Interstate Commerce Commission, they recognized that, when the situation arose in

1914 that the railroads earned only 5.36%, in the Eastern District, on their recorded investment in road and equipment provided for public use, the revenues were too low in the public interest. One can readily see that some minimum, like a return of 6 or 7%, on such property investment might be provided by statute, so that there would not be a repetition of restricted railroad credit, with its disastrous consequences and inadequate facilities for the commerce of a growing country. The speaker cannot see that such a minimum return would be objected to by the country at large, which has never desired weak or poorly maintained railroads, for that means business depression. This plan does not guarantee any return to any single railroad, but it will require, in substance, that the earnings of the railroads in the larger traffic regions of the country (such as the Official Classification Territory east of the Mississippi and north of the Potomac) should have an aggregate return which, as a whole, will always produce that minimum. This will still require each railroad to put forth its best efforts in operation and management to secure its share of the business and serve the public. The Railroad Executives' plan does not name any figure. Those the speaker has given are merely illustrations which, from his point of view, are essential to prevent future mistakes. It is quite usual for the State Commissions to fix rates of return permitted to public utilities. The water company serving the territory where the speaker lives is allowed to earn 7% in excess of operating expenses, taxes, and depreciation. Whether or not the figure is imposed by statute, some protection is essential for railroad credit, because private ownership and initiative cannot continue unless returns are sufficient to pay operating expenses, taxes, and furnish a proper return on the investment so as to provide a proper basis for sound credit. No National railroad policy will be successful without embracing this rule of reason in rate making. That issue in railroad legislation and regulation can no longer be evaded. If it be conceded in legislation, and the railroads are liberated from the restrictive features of the anti-trust laws, and the State laws, what necessity is there for Government guaranties or Government ownership? Every guaranty or security issue of Governmental regional companies must weaken prices of other Government bonds, because the railroad guaranty concerns more than $19 000 000 000.

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*Wage Board.*—The Railroad Executives' plan does not overlook the employees, nor the public necessity for uninterrupted transportation service. It provides for a Wage Regulatory Board, under the Secretary of Transportation, on which the public, the employee, and employers will be represented, so that the impairment of interruption of train movement, with appalling loss to the country, to the employees, and to the company, may be avoided, and lock-outs and strikes prevented.

Mr. County.

Under such a far-reaching plan, the disturbance and economic waste heretofore caused by lack of a National railroad policy, and by divided responsibility, will be avoided, and there is no experimental feature about it. Like all other plans, it is, no doubt, susceptible of amendment, but it is hoped that our future National railroad policy will be adopted by Congress without Government ownership and operation, or Governmental guaranty of non-competitive regional companies, with consequent reorganization of the existing railroads, and with the resulting high transportation costs and paralysis caused by Governmental delays and restrictions, and inevitable stagnation to the future commercial progress of the country.

The following is the testimony of Mr. W. M. Acworth, of England, regarding Government relations to foreign countries, before the Joint Sub-Committee on Interstate and Foreign Commerce, before the Congress of the United States, in May, 1917:

The railway history of France stands by itself. Nowhere is the passion for logic and the love of symmetry which distinguish the French genius better exemplified than in the history of the French railway system. The ground plan of the policy which, broadly speaking, France has followed ever since, was laid down in a law passed as long ago as 1842. There were important developments after the world crisis in 1857, and again in 1878. And on January 1st, 1909, the Government, by taking over one of the six great systems, the Western, upset the symmetry of the original plan. But, with this exception, throughout the whole history the original plan has stood firm. The whole country was divided up among six great companies, five of which radiate from Paris, and the sixth, the Midi, serves the extreme South and Southwest. The development of the railway network has been systematic from the outset; trunk lines first, then important branches, then the less important ones, and finally in recent years a considerable development of light secondary lines. Throughout, the State has guided, subsidized, and controlled. Each company has a monopoly of its own district. So far as possible, the points where the great systems meet are arranged not as in Hollond, or formerly in Italy, at the great towns, but precisely at the points of least importance from a traffic standpoint. Where traffic is unavoidably competitive, as, for instance, from Paris to Central Switzerland, which can be reached either by the Eastern or by the Paris and Lyons Railway, arrangements are deliberately made to prevent competition. The Government controls all rates and fares charged and all services given, and the Government approves, not merely of pools, but of agreements by which shippers attempting to consign traffic by the route by which the railway companies have agreed the traffic shall not flow are deliberately penalized by higher rates. At a later stage of this paper more must be said of the work which the French railways have done, and reasons will be given to show that the French private companies have served their public at least as well as the Prussian State railways have served theirs. But it belongs here to deal with the history and the results of the nationalization of the Western Railway eight years ago.

Mr. County.

For more than 30 years the French Government have owned and worked a system of lines in the Central West of France. This system was not inconsiderable in mileage (1 844 miles), but its district was purely agricultural and its traffic scant. It only reached Paris over the lines of the private companies, and, even when it served important towns such as Nantes and Bordeaux, it only served them by inferior routes. The financial results were very unsatisfactory—the operating ratio over a series of years ranged between 72 and 83%—but in some respects, as, for instance, admitting third-class passengers on all express trains, it gave to the public advantages which the private companies did not give.

Among the great companies, much the weakest financially was the Western. A large portion of its mileage was in Brittany, one of the poorest districts of the country. It did serve the town of Rouen and the very important port of Havre, but the canalization of the Seine diverted from the railway a large proportion of the valuable merchandise traffic between Havre and Paris. The French Government guarantees the dividend on the shares of all the French railway companies, and year after year the French Government had to find a considerable portion of the dividend to the Western shareholders.*

Further, large new capital expenditure was needed, especially to cope with the enormous passenger traffic of the company in the suburbs of Paris. How heavy that traffic is anybody who remembers the St. Lazare Station in Paris will know. The necessary capital could not be raised without Government approval; and Government approval, owing to strong parliamentary opposition, could not be obtained. Meanwhile, the service was going from bad to worse, and the equipment was on its last legs. Something had to be done. Once more the knot that could not be untied was cut; and, as from January 1st, 1909, the Government exercised its rights under the concession, and took over the railway, continuing to pay the guaranteed dividend to the shareholders in the form of an annuity running until the termination of the concession.

The political history of the transfer is distinctly interesting. The employees on the railway itself were unanimously in its favor; and, as subsequent experience proves, with good reason; and the whole strength of the Socialist Party and of socialist sentiment was thrown on the same side. A majority was secured for the bill in both houses, though a large majority of the representatives of the districts served by the railway voted against it. The bill passed the Chamber in December, 1906; but it was hung up in the Senate for 18 months, until June, 1908, and finally only passed by a majority of 3 votes, after M. Clemenceau, who was Prime Minister at the time, had given it to be understood that unless the bill was passed he would resign; and, much as the majority of the Senate disliked nationalization, at the moment they disliked the resignation of M. Clemenceau even more. It may further be added that, according to the French custom, the opinion of all the chambers of

* It should be noted that only 10% of the total French railway capital is in the form of shares; 90% is in the form of bonds which practically, though not formally, are guaranteed by the French Government. The dividend on the shares, therefore, though large in percentage—it ranges from 7% on the Western and the Eastern, and 10 or 11% on three of the other companies, to 13% on the Northern—is not very large in total amount. Broadly speaking, the companies other than the Western more or less earn their dividends in normal times without State help.

Mr. County.

commerce in the country, which are statutory bodies, was invited on the measure, and that not one single town of more than third-rate importance reported in its favor.

*Experience of State Operation in France.*—Here in broad outline is the story of the result of the transfer.* In the 5 years, 1904-08, before the transfer, the gross receipts rose steadily from $37 084 000 to $42 145 000. In the 5 subsequent years, 1909-13 (the war upset entirely the figures for 1914), the gross receipts rose from $42 333 000 to $48 701 000, a slightly greater rate of increase. In the 5 years before the transfer, the operating expenses rose from $20 796 000 to $28 388 000, this last figure being unduly inflated by the fact that, from the date the chamber voted the acquisition of the railway, the staff became entirely demoralized. The first year after the acquisition the operating expenses were $30 304 000. The next year they were $34 921 000, and the year after, $39 454 000. In 1912 they had reached $41 800 000, and for 1913 they fell back to $41 478 000. In other words, to earn a net revenue increased by 31% the operating expenses increased by 100 per cent. The net revenue was never below $13 757 000 in the worst year of company rule. It fell to $5 352 000 after the Government had been in possession 4 years. The operating ratio, which had risen from 56.4 to 67.8 under the company, was for the next 5 years as follows: 72.7, 79.9, 87, 89.4, and 85.2. It is fair here to make a qualification. The operating ratio had gone up on all the French railways between the two periods. It averaged 50.3 for the other five great companies for 1905 and 1906, and 58.4 for 1912 and 1913; but a rise from 50.3 to 58.4 is one thing; a rise from 56.4 to 89.4 is quite another.

A main argument used in Parliament in favor of transfer from the company to the State was that the company never did, and never could, earn its guaranteed dividend in full, still less the extra dividend which it would be entitled to if earned; that the company was accordingly a mere caretaker, and not interested in financial results, and did not operate, and could not be expected to operate, with economy. The State, on the other hand, would have a direct interest in operating economically. That was the argument. Here are the facts: During the last 10 years of company management, the State had to pay an average of $2 894 280 a year to meet its liability under the guaranty to make up the deficiency in net operating income. During the first 3 years after the transfer, the sums it had to find, under the same head, were $6 753 320, $8 875 792, and $14 934 484, respectively. For 1913, the figure was $14 752 237.

Nor do these deplorable financial results tell the whole story. The service to the public was absolutely demoralized. There were several very serious, and numerous smaller, accidents, and the staff and the public got so frightened that the express trains on the main line, already

* The figures given are from official sources. The story is mainly taken from an article by Pierre Leroy-Beaulieu, himself a Deputy, in "The State in Relation to Railways" (P. S. King and Company, London, 1912). See also Colson in "Revue Politique et Parlementaire" for November, 1910; December, 1911; May, 1913; and May, 1914. The railway newspapers all over the world were full of the story in 1909 and subsequent years. M. Colson, an engineer by training, was formerly head of the Railway Department of the Ministry of Public Works, and is now President of the Section of the Council of State (a body partly executive and partly judicial), which deals with all questions concerning transport by rail, or road, or water. His book, "Transports et Tarifs," is a recognized classic on its subject.

the slowest in France, were decelerated down to a timing that had been abandoned as inadequate in 1896. In addition, a number of trains were suppressed altogether. Punctuality went to the winds. Commuters on the system in the suburbs of Paris were compelled by their employers to live elsewhere because of the unpunctuality of their arrival at their work. As for the service in general, one figure will suffice. Compensation for accidents, loss and damage, averaged some $400 000 or $500 000 a year in the last days of the company. In 1911 the figure was $2 045 291. The Minister of Public Works himself publicly criticised the State administration as "a frightful fraud." And the Senate passed unanimously a resolution beginning: "The deplorable situation of the State system, the insecurity and irregularity of its workings * * *."

Mr. County.

M. Leroy-Beaulieu gives the reasons for the "deplorable situation" as follows:

"In the first place, it is the abuse of formalism and red tape, with all the delays which follow and which are directly in conflict with commercial needs. In the second place, it is the lack of stability. The director and all the chiefs of the service change at the will of the ministers, whilst in the private companies the higher personnel is maintained a long time, fulfilling the same functions. It is next the political influence which enters into the choice and advancement of the personnel. It is, lastly, the lack of discipline which also results from the political influence at work. From the electoral point of view, the lower staff, being much more numerous, will always have much more power than the superior staff. It is always on the side of the former that many deputies will be systematically ranged. Above all, it is impossible to be at once controller and controlled. If one of the great French companies under private management renders poor service, the public opinion is not slow to move the public power, and as this has the means to bring pressure indirectly but in many ways upon the companies, they are led to reform. On the contrary, when complaints are made against the State itself, the administration, irresponsible, does not listen. Rather, it seems indignant that particular individuals or even large associations should dare to find that all is not perfect. 'I have not seen without a certain astonishment,' said the minister of public works, in the chamber, 'the chambers of commerce criticise the actions of the State in its (their) reports upon the railways.' The same minister has dismissed an employee from his office who was at the head of a section of a passenger line which emitted protestations against the delays on the western State service in the Paris suburbs. When the minister was reproached in the Senate, he declared himself ready to do the same again. One may see how dangerous to the liberty of citizens the extension of the industrial régime of the State would be, where the number of functionaries would be indefinitely multiplied and where they would no longer have the right to complain.

"From all points of view, the experience of State railways in France is unfavorable, as was foreseen by all those who had reflected upon the bad results given by the other industrial undertakings of the State, such as telephones, matches, and many others. The State, above all an elective administration, cannot be a good commercial manager. It works expensively, and is powerless before its employees. The experience which we have recently gained has had at least one result. It has

Mr. County. provoked a very lively movement, not only against the repurchase of the railways, but against all extension of State industry. This result seems to me fortunate. I hope this opinion will be maintained and that not only we, but our neighbors, may profit by the lesson of these facts."

M. Leroy-Beaulieu gives examples of what has happened under the various heads. "As for formalism and red tape," on the eve of the handing over of the railway to the State there were 1 526 employees in the central office. Within three years the number had increased to 2 587. "The single service of the accountant general was increased by 70 persons directly after the repurchase." And this was partly due to political pressure and partly to excessive red tape. For example, in the Caen Division, the preparation of the pay sheets which, under the company, took 9 persons 3 days = 27 days, under the State administration took 12 persons 6 days = 72 days. "According to official documents, there are not less than 96 persons receiving a salary of more than $1 929.52 in the State system" as against 33 on the system of a neighboring company of much the same mileage, but with much higher receipts. In the 5 years from 1908 to 1912 the total expenditure increased $10 573 770, of which $8 412 707 were for salaries and wages.* In 1908, out of every $19.30 of receipts, the company paid $7.24 in salaries and wages. In 1912 this figure was $9.70. The comparative figure for the five great companies is only $5.70. In 1910, per $192 952 of receipts, the State railways employed 235 persons, the private companies 174.

Again, as the result of the great strike of October, 1910, the Chamber of Deputies voted a large all-around increase in the wages of the staff. Naturally, the staff thought there were shorter cuts to increases of wages than hard work. As a sample of want of ordinary business management on the financial side, the budget commission of the chamber reported that it could not draw up a proper estimate for 1912 from lack of the necessary accounts. "The statements addressed to the budget commission by the administration were manifestly inaccurate. * * * The great part of the statements of receipts and expenditure were found to lack any sufficient justification. Thus, as regards the expenditure upon personnel, the tables accompanying the statement only stated the numbers of workmen and staff and the amount of their salaries in round figures. * * * We wrote for further statements, more particularly the numbers of the personnel. * * * The minister replied (three years after the railway had been taken over) that the enumeration of employees had not yet been made. * * * This example suffices to show the trust that may be placed in the other parts of the budget estimate." This is not the opinion of an outside and unfavorable critic. It is the report of a committee of the chamber of the same political complexion as its predecessor, which voted for the purchase, based upon a draft drawn up by a deputy well known as an advocate of State ownership.

One story given by M. Leroy-Beaulieu is so striking, as a sample of the highest quality of red tape, that it deserves to be given at length. It is from a letter of a station master read in the Chamber of Deputies:

* The 1912 figures are budget estimates only.

"In the time of the Western Company we station masters had orders to use the rolling stock as quickly as possible and to send to a given station all that we did not ourselves require. Under the State all is changed. Every station master is forbidden to load any wagon without the orders of the distribution bureau of the district. This bureau is, as is well known, a new creation, specially designed for the purpose of finding situations for so many more bureaucrats. Recently, having received two wagons loaded with horses, accompanied by an order to send these wagons to Caen after they were unloaded, I thought to do well by loading in these two wagons 200 sacks of grain, which had been waiting in the sheds for several days to go to Caen. But, alas, I did not know the bureau of distribution. The next day I saw my two wagons return, and I received at the same time an order to unload them. I was reproved into the bargain for excess of zeal. I had to obey the order. That evening I sent the wagons empty to Caen. Next day I received two others, also empty, in which to load the grain." Mr. County.

GEORGE W. KITTREDGE,* M. AM. SOC. C. E.—The Society is to be congratulated on having Mr. Stuart speak on the railroad situation, for no other member is better qualified. He has had to do with the construction and operation of railroads, has been connected with the Federal Administration, and is qualified to judge of their requirements and to realize their position. Mr. Kittredge.

In reading this paper, before coming to the meeting, the speaker was reminded of the story of the countryman who had been reading Plato, and said: "I rather like that man Plato; he has got so many of my ideas."

Mention has been made of the fact that railroads seldom hear from consumers in regard to rates. There may be good reason for this. A rate that is of material benefit to a carrier may have an almost unappreciable effect on the actual price of commodities. For example, an increase in freight rates was asked by the carriers a few years ago, which, if fully granted, would have substantially increased their revenues, and have given them, at that time, a living income. This increase in rates, which meant so much to the carriers, made a difference in the cost of a pair of shoes transported from Lynn, Mass., to Chicago, of one-quarter of a cent per pair.

Emphasis has been placed on the necessity of something being done to take care of unproductive expenditures, such as those in connection with large terminals, and with grade crossing elimination. With a large terminal, like the New York Central, if it were not possible to secure revenue from tenants in, around, and over the station and tracks, the carrier would be very severely affected financially by the enormous expenditures.

Where grade crossings are eliminated, the cost often runs into tens and hundreds of thousands of dollars, and yet it is doubtful if one

* New York City.

Mr. Kittredge.

dollar of added income comes to the carrier by reason of the grade separation.

It costs more to handle a commuter from Yonkers or Mount Vernon through the Grand Central Terminal than the gross amount of money received from that commuter for his ticket, leaving to the carrier the privilege of bearing the expense of housing him at his outlying station and conveying him to and from the city.

On one of the railroads terminating in New York City there are projects being urged for terminal improvements, grade crossing eliminations, and the like, which, if carried out, will involve expenditures of $25 000 000. If some equitable and comprehensive scheme could be devised for taking care of such expenditures as would be unproductive of revenue, those projects might be carried out with benefit, safety, and comfort to the public, giving employment to men returning from military and naval service and war activities, and largely benefiting communities in which such projects are to be undertaken. It is out of the question under present conditions for the carriers to consider such projects. Facts of this sort are not realized as they should be by the public, and Mr. Stuart has done well to dwell on the necessity of making provision in some way for such unproductive expenditures. Such expenditures must be made. They are necessary, from the standpoint of the carrier, as well as from that of the public, and if criticism is to be offered in regard to the amount to be thus expended, it must be that too little, rather than too much, has been expended in this way in the past. Those deeply interested in the railroad situation would do well to give this phase of the subject careful attention.

The welfare of the entire country is intimately affected by the railroad situation. The producer, the shipper, the merchant, the consumer, the investor, and those who prudently try to provide for their families and dependents after their own working days are over; all these, added to the hosts of employees who are necessary in the construction, maintenance, and operation of the carriers, make a vast army of people whose welfare, directly or indirectly, depends on the stability and financial integrity of the railroads. Statements, made in moderation, giving facts and statistics, together with sane discussions such as presented in this paper, are needed and should be encouraged; for the value and necessity of the railroads, and the well-being of the country, are too great to be jeopardized.

Mr. Tomkins.

CALVIN TOMKINS,* ASSOC. AM. SOC. C. E.—The speaker has not had an opportunity to read this paper and cannot discuss it as carefully as he would like. It is fortunate that a gentleman who knows so much about railroads, and who has also had Government experience, has undertaken to discuss the question at this time.

* New York City.

Mr. Tomkins.

There is no doubt that competition under private initiative, such as we had during the period when our railroads were being developed, is more economical and more efficient in every way than Government ownership and operation; but have we sufficiently considered changed and changing conditions? If there is any way by which the country can preserve the advantages of private initiative, by all means it should do so.

The railroads of the country were developed under the leadership of its brightest minds, by a process of the most intense competition. That competition, consciously or unconsciously, had one end in view, which was the consolidation of the many railroad systems into one. For fifty years steady and obvious progress was made away from many systems toward a few systems, and an unconscious progress toward one system. We have attained the ultimate end of this process of natural selection, and the only reason that the process did not reach its logical conclusion under private control, was because the War intervened and precipitated the end under Government auspices.

The Sherman Law temporarily interfered with the personal consolidation of systems, and prospective bankruptcy stared most of the roads in the face as a consequence of the National policy of starvation which increased expenses without permitting corresponding increase of revenue. The railroads were not permitted to raise their rates, and their living costs kept on increasing. This greatly accelerated the tendency toward failure and ultimate absorption of the weaker by the stronger roads. The War, however, brought out the defects of the system under the Sherman Law, and as these defects became apparent, the separate systems were put under one control for war purposes.

From April until September, 1918, the speaker served as a member of the Inland Waterways Committee, a branch of the Federal Railroad Administration. The Committee made its report as to what should be done with the waterways to help out the railroads, which in the Spring of that year could not carry the freight. Executives were put in charge of the Mississippi River and Erie Canal, and traffic on them was developed.

Not later than September in that year the situation had entirely changed. The consolidation of the railroads and the efficiency of their operation as one system under the best executives, had brought about such a degree of relief that the aid of the waterways was no longer needed. Freight was even diverted from the Erie Canal to the railroads, and there was much criticism in New York State for permitting this and thus limiting the use of the Canal. The principal freight carried on the Canal was grain from Buffalo eastward; and Mr. McAdoo, at that time, acting as the Trustee for the owners of the roads, was protecting them, and properly doing so, against the competition of the waterways.

Mr. Tomkins.

Mr. McAdoo has asked, since he left office: "What is the use of developing the waterways system of the country if it is to be put back into the old competitive relation with the railroads?" The railroads had virtually succeeded in destroying water competition, except coastwise and on the Great Lakes, and this was necessarily done as a part of the competitive game in which they were engaged.

The situation will in truth be a difficult one for the railroads and for the canals if the old destructive competition is permitted to reassert itself, and the speaker will now ask the complementary question: "What will become of the railroads under such circumstances?" Waterway competition has immense possibilities, which thus far have not been realized. Heretofore, the waterways, and especially the Erie Canal, have been mismanaged by politicians, unprovided with adequate terminals or any reasonable system of prorating with the railroads.

Now that the public is interested in the waterways and highways, there will arise an insistent and increasing demand that there shall be established a fair system of prorating between rail and water commerce, and that the waterways, like the highways, shall be modernized in all respects. If the railroads shall again temporarily go under private control, this waterway competition will without doubt be intensified. The Railroad Administration, which is still very properly acting as Trustee for the holders of railroad securities, has held in check this competition, but if the Government shall in the future encourage full and free competition between quasi private railways, and public waterways and highways, the result cannot be otherwise than disastrous for the railroads and, the speaker may add, harmful to all three factors.

Any one who has witnessed the volume of traffic on the Rhine and its connecting canals knows the possibilities of waterways, without many locks, such as we have in America and such as exist in Germany. In the speaker's judgment, Government control over these three factors of transportation is essential, if we are to avoid the uneconomic consequences of unnecessary competition. The railroads have also to consider the question of competition with modern highways. A large part of their most profitable traffic has heretofore been the short hauls; but now, any haul over good roads within 50 miles from point of origin to point of destination can be performed more effectively by motor truck than by the railroads handicapped by the intervening transfers.

Existing public sentiment may perhaps be temporarily against Government control, due to recent wartime experiences, but the speaker believes the pendulum will soon swing the other way, since, judging the future by what has occurred, we perceive that a steady progress toward consolidation has characterized the railroad history of our country, which has been a record of exploitations, absorptions, expansions, and bankruptcies, and then the same processes repeated over and over again, the units being larger each time. That is what occurred

under the most efficient railroad generalship that has ever been had. It has been the lack of guaranties, lack of any certainty or safety, and the great risks incurred, which in the past made the railroad systems of the United States so effective. All this was accomplished under a régime of most intensive competition. Projects to raise fur on domestic animals have never been successful. It requires the hardship of exposure and wild life to bring out the fur. It is the same way with railroading. It required the law of natural selection, operating freely, to bring to the front the kind of men who developed our railroads, and produced such wonderful results, culminating at last in the greatest railroad system of the world. The competitive conditions which produced these men and these grand results, however, no longer exist. How, then, is it possible to expect to base any system of railroad operation on them? How can we provide competition, when the elements of competition are no longer here? Mr. Tomkins.

Are not the proposed "regional systems", equipped with "Regional Directors", in supposed "service competition" with each other, merely camouflaged semblances of the older order of real things which has passed away?

Is not this proposed machinery a mere pretense which may obstruct rather than serve the purposes of operating a national railroad system, already unified?

Are not the proposed regional zones, with their directors, comparable to the several floors in a single department store with their respective floor managers in charge?

The Government determines freight rates, wages, hours, schedules, routeing, joint operation of terminals and ticket offices, safety devices, issue of securities, uniform accounting and, most important of all, credit—and there is general agreement that these Governmental powers should be perpetuated. What else, aside from the purchasing and allocation of supplies, is there which can possibly be delegated to private initiative? The genius of Commodore Vanderbilt, C. P. Huntington, E. H. Harriman, and J. J. Hill was not exercised under conditions such as those just outlined. The ultimate object for which they, consciously or unconsciously, competed so strenuously, and which has at last been achieved all the more quickly as a result of the War, was a unified system, and railroad competition is now as dead as they are.

A Government guaranty, direct or indirect, to the effect that rates shall be sufficiently high, both to recompense invested capital and to attract new development capital, is, in the speaker's judgment, and under existing conditions, less desirable than will be a public valuation of railroad securities, accompanied with a guaranty of interest based on such valuation. All rate making and responsibility for all expenditures should be left to the general Government which, in the end, must hold the bag, under all suggestions which have so far been made.

Mr. Tomkins.

A guaranty of payment of interest on outstanding securities is a simple and direct obligation of the Government, easily understood, and, if once undertaken, not likely to be avoided. The delegation of the power to initiate rate making on a basis sufficiently remunerative to provide for all contingencies, and to include a speculative profit in addition, will be a more complicated obligation for the Government to enter into, and one which is much more likely to be avoided in the future. Speculative profits are elusive. Interest payments on railroad securities transmuted into Government bonds are definite obligations.

As to a division of prospective profits between operators and security owners to serve as an incentive to enterprise, the answer is that it is not likely that there will be profits, and, if there are, the operatives will demand them all and probably will get them, to the exclusion of the holders of securities.

The unscientific existing railroad rate structure must be revised. It underlies many of our past railroad troubles, and is the resultant of a variety of forces operating over a long period of time, prominent among which are to be noted the following:

Actual or potential water competition; "what the traffic will bear"; "what was necessary to move traffic", and, finally, equalization of the opportunities and defects of localities.

A juster appreciation of the cost of service and the separation of terminal from line haulage charges, must be given greater consideration in rate making hereafter, or the annual railroad deficit may be disastrous. Interstate Commerce Commissioner Robert W. Nolley has ably discussed this matter.

The average security owner is as careless of his vote as is the average citizen, and, consequently, ownership, whether public or private, is comparatively immaterial. The roads have always been run, are being run, and will continue to be run, by expert operatives, from the track boss up through the engineering and accounting staffs to the President and the Director General, and the sooner this fact is recognized by the Government and the public and by security owners, the better it will be for all concerned. The quality now most needed for efficient operation is the development of *esprit de corps* in the operating staff, which in time will generate efficiency—not indeed as satisfactory as that which existed before competition ended, nor as bad as politics alone can otherwise make it.

Efficient services rendered to the public, not for bonuses and tips, but for just wages and salaries, in a distinguished and honorable employment, is what the country requires and may ultimately expect from the operating staff.

Absolute security founded on a just basis of values is what the security owner most needs—in other words, a Government bond—and if he delays much longer to press for this, in the hope of securing the

elusive chance of higher speculative profits, based on politically delegated control over rate making, he is likely to miss his market. Mr. Tomkins.

AUGUSTUS SMITH,* M. AM. SOC. C. E.—The speaker is not a railroad man, and will not attempt to discuss this paper from a railroad standpoint. As a freight shipper, and as a typically insignificant "private owner," if that is what a stockholder or bondholder is called, he does not think that the railroads as a whole have been particularly well run when under so-called "private ownership." Mr. Smith.

For instance, though the Baltimore and Ohio Railroad has been improving steadily in the last ten or fifteen years (and doubtless a large share of the credit for this must be due to the author) and for many years before that, the communities served by it were afflicted by a poverty stricken railroad, and the blighting effects of that condition can be seen to-day in Staten Island.

The list of badly financed, or exploited, and wrecked, railroads in the United States is a long one, and the list of people who have lost money in railroad investments includes nearly every one who has laid aside money since railroads were first started. The New Haven crash will not be forgotten soon in New York or New England. War or Legislative interference had nothing to do with this. It was one of the most "privately owned" of "privately owned" railroads, and seemed to have enjoyed the acme of private management.

The concluding paragraph of the paper states the following fact that every one will endorse:

"The entire matter is of such importance to the whole country that, if this session of Congress cannot settle the question, then an extra session should at once be called for this purpose."

We are now forced by the problem of reviving business and sustaining wages. The railroads, in time of peace, are the greatest purchasers of materials and building construction, and hence are the greatest agencies for indirectly employing labor, in addition to their own enormous pay-roll. Their ability to purchase and thus develop their property was curtailed for several years before the war by stringent legislation and by alienated public confidence. The railroads to-day, therefore, present the greatest opportunity for active constructive industry to furnish employment and maintain wages, if they can be promptly put in a position to catch up with their retarded development.

Furthermore, general industry is so dependent on railroad service and railroad rates that any uncertainty in the railroad situation is bound to act detrimentally on the general resumption and expansion of activities.

The author points out the political dangers and the lethargy and stagnation that would probably come with Government ownership, and evidently thinks that "private ownership" with proper regulation and

* Bayonne, N. J.

Mr. Smith.

control is to be preferred, notwithstanding the experience we had before the War; but, were it not for the loyal railroad engineers, the "owner" or "owners" of a railroad surrounded by labor unions, Interstate Commerce Commissions, State Legislatures, grade crossing laws, damage suits, lawyers and juries, and represented by financiers, would be in a sorry predicament.

The Federal Government has made great expenditures, and contemplates making much greater ones for the improvement of our inland waterways. It is considering the development of an Atlantic coastal waterway. It has taken over the Erie Canal and the Cape Cod Canal. It has long been in charge of navigation on all tidal rivers and estuaries and on the Mississippi River and the Great Lakes. None of these waterways, except the Great Lakes, can be appreciably utilized for transportation of freight, except in conjunction and co-operation with the railroads. The railroads, hitherto under private management, have deemed it to their own best interests to deny co-ordination with any water-carrying artery, and when it was impossible to throttle and paralyze the movement of water-borne freight, they have deemed it necessary to enter as savage competitors on the water.

The country is now launched on a great shipbuilding programme, and we are wondering how we can get the products of our country and its overseas purchases to and from the ocean and interior in the most economical and expeditious way, quite irrespective of giving the haul and greatest freight return to this or that railroad corporation. We are wondering how our ports should be arranged to reduce the tariff or tax exacted in the way of transfer expenses at the point of transhipment from rails to the sea.

We have watched for years the growth of interlocking directorates and money interests, whereby the same individuals and corporations are monetarily interested in the railways and in great industries depending on them for an outlet, and whereby, in various ways, such individuals and corporations have obtained an unfair advantage over competitors in special railroad rates and railroad service, and we have tried to remedy this evil by legislation and other makeshifts.

We have long been accustomed to itineraries of carload shipments that remind one of the travels of "The Flying Dutchman". L. C. L. shipments passing over several lines to their destination need not be expected until they turn up of their own accord. In shipping from Bayonne to Boston, for instance, the railroad is not comparable with trucking to New York and then by the steamship to Boston, even at considerable greater expense by the latter route.

We probably are all willing to concede that Federal management of the railroads would mean freedom, or at least equality of land movement—freedom of the land—and would permanently abate the preferential evils we have been trying to reach by legislation.

Mr. Smith.

We may be able to visualize partly the great economic advantages that would ensue if the water routes and the railroads were operated so as to feed each other with business, and if the ports were operated as links in our transportation system, having a duty to perform to the producers and consumers, unmixed with the perquisites of a quasi custom house. Great improvements in handling freight are possible. The rates for carload shipments can probably be reduced. The time for all shipments can be greatly reduced. The suspicion or certainty that some interests get an unfair advantage over competitors in railway service can be done away with entirely.

The railroads are our long-distance highways—turnpikes of the first class. There is no more reason for their being operated by and for the benefit of private individuals than that we should return to the old system of privately controlled turnpikes. Of course, the present owners of these highways must be equitably compensated for their property, and the provisions of the existing contract whereby the Federal Government took over the railways, if the properties are to be retained by the Government, are probably satisfactory to the great majority of holders of railroad securities.

Let us keep before us the conception of a great system of highways owned and operated by the public. We do not need to include every railway in that system, nor do we need to include the operation on such a system of highways of all vehicles by the public. Pullman service, dining cars, refrigerator cars, coal cars, *trains de luxe* for passenger service, long-distance freight, and all express service could be properly operated over the public highways by private enterprise. In fact, the railroads have been doing this very thing for years with each other, over leased lines, and by leased privileges. All that has to be done now is to let the Government hold the lines, or such of them as seem necessary to the Federal management, and be the landlord. The old railroad men will be available to provide car service. If new lines have to be built, private capital and initiative can be enlisted on equitable terms, and if politicians or self-seeking communities try to have new railroads built at Federal expense, the economic advisability of the proposed construction could be passed upon by Federal engineers, who would be as able and incorruptible as have been the U. S. Army engineers for years past in dealing with our navigable rivers and harbors, holding down expenditures to what would actually be of some benefit to commerce.

One of the evils that has impoverished railroads, and that the general public is now going to pay for in the increased transportation charges, is the abuse of grade crossing legislation, mentioned by the author. Baiting railroads has been popular in every State Legislature and town council. If the roadbeds belonged to the Government, grade

Mr. Smith.

crossings would be eliminated where necessary, but this would cease to be a political and popular sport.

It might be feasible to have the Government take over with the roadbeds and terminals—that is, with the real estate—the locomotives, train crews, and signal or communication systems. This principle has long been proved practicable under private ownership in the many instances where the trains of one railroad corporation are hauled over the roadbed and into the terminals by the locomotives and train crews of another. Under such an arrangement, strikes threatening interruption of mail service and even starvation for cities could not occur.

If competition is necessary for progress, as the author says it is, it would be possible to have several different corporations competing for business on the same rails, just as the Pennsylvania Railroad and the Central Railroad of New Jersey have competed on the right of way of the New York and Long Branch Railroad for many years. In fact, if the Government chose to put on a car service too, to make a base rate and provide, for argument's sake, a base service, we might rely entirely on competition to regulate the rates charged by private corporations, and dispense with the Interstate Commerce Commission, or at any rate, relieve that Commission of many of the duties it had before the War.

If the Government handled the locomotives and train crews, it would be responsible for train accidents, and some sort of accident compensation, fixed by schedule, would take the place of damage suits, juries, lawyers, and punitive verdicts bearing no relation to the money paid to the railroad by the victims of the accident for their tickets.

Finally, the railroads on which people depend for service when they settle in a country and invest their life and money in some enterprise, would be taken out of the stock markets and placed under a guardianship that could not go bankrupt or be re-organized, and that would treat every citizen in every part of the country by the same policy.

Private ownership is a thing of the past. It has long since been a name only. Public ownership exists now. How shall it best be administered? Shall we go back to the fictions and elaborate artificialities of the recent years, made more elaborate by statute upon statute, as one difficulty succeeds another, just as any lie rolls along, growing like a snowball; or, shall we recognize the true relation between control and ownership?

Mr. Bernhard.

JOHN H. BERNHARD,* ASSOC. M. AM. SOC. C. E.—Undoubtedly, the author has advanced very valuable ideas on the question of public or private ownership of railroads, and yet it seems to the speaker that the seat of the trouble is deeper than his suggested remedies go. The underlying difficulty in the railroad problem is the rate system.

Using the term in its broadest sense—that of determining the amount to be paid for service rendered—it is evident that, if a satisfac-

* New York City.

tory rate system is adopted, it matters little whether we have public ownership or go back to private ownership; in fact, it seems logical to assume that, with such a satisfactory solution, even the most ardent supporters of public ownership would become lukewarm, unless they were advocating such public ownership for political spoils, and thus disqualifying themselves. Mr. Bernhard.

The objection to the private interest is not against men, but against their methods and systems. The public would not be better off with Government ownership under the old system.

The rate problem can be summed up in a very few words: the so-called rate system is no system. It is an impossible fabric of the following principal considerations:

What the traffic can bear;
Anything to beat water competition;
Anything to beat competing lines;
Anything to secure tonnage;
Compromises—increases or decreases in rate based on what some other community has to pay to reach similar destinations, etc., etc.

We have no rate system. It just so happens: that is all that can be said for it. It grew naturally. It is self-made in its worst results. To a great degree—more so in the past than at present—the railroads have, if anything, helped increase its entanglements and its difficulties. Although the United States grew in a most remarkable way, the rail-rate system just grew locally, and, later, was patched together, with the result that this rate scheme is based on everything except cost-plus-profit.

A few illustrations of freight rates may elucidate this: Before the war, in carrying salt from Syracuse to St. Louis, a direct distance of about 900 miles, it was shipped *via* Baltimore, a distance of about 300 miles, reloaded at a cost certainly not less than 30 cents per ton, carried by water to New Orleans, a distance of 1 700 miles, reloaded again at New Orleans, again at a cost of not less than 30 cents per ton, and then carried up by rail to St. Louis, a distance of 700 miles, cheaper than if carried direct to St. Louis. It must be clear that the people as a whole pay somehow for this loss of labor, time, and misuse of investment; and the statement that such a commodity thus carried around may be moved cheaper than in another country is begging the question. The point is that it is moved 1 000 miles by rail and 1 700 miles by water, and handled twice, whereas it could have been moved 900 miles direct, without such rehandling. We should look on foreign countries as our rivals—friendly, perhaps, but rivals nevertheless—and, therefore, we should practice economy as far as we can, and not content ourselves with a statement that as a whole our freights are

Mr. Bernhard.

cheaper than elsewhere. Let us take advantage of our natural resources and not waste them, even if, in the minds of some, we have sufficient margin of profits.

If flour, a difficult article to carry, with its inevitable claims for damages, is carried from New Orleans to St. Louis at a rate per ton-mile which is equal to or less than that at which coal is carried in open hopper cars in Pennsylvania (3 mills per ton-mile), that flour is certainly carried at a loss.

Why should a community which is in the interior and away from water facilities pay frightful freight rates in order that a community on a water route may move its commodities below cost? All "rate differentials" (better called "rate arbitraries"), all comparative rates, all these evils sap our energy.

We have played more or less into the hands of the railroads in the past by creating a ponderous Interstate Commerce Commission, which sits with such great dignity in Washington. To the speaker its top-heavy deliberations often appear as mirror reflections of an imaginary committee which meets for the purpose of discussing carefully how to eliminate or alter a wave in mid-ocean. A commissioner is sent out and the wave is photographed, a bluff is made at measuring it, it is reproduced, a wax model is made of it, and after all data have been collected, the matter is laid before the parent committee, which goes over all the records, finds the center of gravity, buoyancy, specific gravity, has some cuts made, and borings, and determines whether or not it is homogeneous, in order to decide the best and most economical way to smooth out that particular part of the wave, only to find that, after its carefully prepared decision, the wave has disappeared.

It would be very difficult to decide which is the greater evil, the rate systems, the Interstate Commerce Commission, or the conception of transportation by some old-time railroad "pioneers." Unconsciously, the Interstate Commerce Commission has been saturated by that all-penetrating conception of rate-making that the railroads have forced on the public mind and which has permeated America like a chilly fog, blanketing and retarding progress. Although perhaps some members of the Interstate Commerce Commission were willing to remedy this evil, when appointed they are placed in the straight-jacket of the law based on the rate evils, and are not able, laden down with decisions and handicaps, to undertake the David's task of killing this Goliath, even if this Goliath has clay feet.

The speaker has tried to follow the Interstate Commerce Commission, and honestly attempted first to read all its decisions. Then he had to content himself with owning the publications, and now even this has to be given up, unless larger offices are rented to find room for the gigantic library that is turned out of this grist mill. It is far beyond a shipper, it is far beyond a transportation engineer, to understand that

labyrinth. It has become necessary, for a great number of years, to employ special legal experts who devote their lifetime to rates. It is for this reason that every local community, Chamber of Commerce, Board of Trade, Business Men's League, etc., employs traffic managers, traffic commissioners, rate clerks, or whatever their titles may be, for the sole purpose of interpreting rates or trying to get special rates, even if it is at the cost of others—yes, entirely regardless of whether it is at the cost of the United States in general, or any community in particular ("pork barrel" patriotism). It is most customary for one community to try to get the rates of another community raised because they are entitled to a "differential", meaning that, for some reason, born of error and evil, they should be entitled to carry their products into a certain field cheaper than another community. The question of cost of carrying does not enter into consideration. Mr. Bernhard.

The proper rate system should be that of terminal charges plus cost of transportation and profit. All railroads should deliver their freight to warehouse doors on sidings, if such exist; otherwise by drays. It is a comparatively simple matter to determine the cost of carrying such freight to and from the proper starting points (freight-yards). Such collection or distribution of freight points to the vital necessity of public ownership of terminals, belt railways, switch-yards, etc. To determine the cost of carrying between terminals is a problem the solution of which is not at all impossible or impractical. In fact, on certainly 90% of the articles carried in America we can determine the cost of transportation very accurately.

Of course, the cost of moving freight in certain communities and localities depends on the density of population and on topographical conditions; in other words, if this principle is carried through to its logical conclusion, it will be found that a certain railroad will have to charge a higher rate than a competing line, because the cost over its system would be higher than the cost over others; but, nevertheless, rates should not be maintained below a just level because a railroad cannot get the freight under its correct rates. It is a logical conclusion, and must be accepted on its face, even regardless of results. There is no reason why a shipper in one State should pay a higher rate than cost-plus-profit in order to pay in part for the freight of another shipper elsewhere who pays less than cost-plus-profit. As each community develops, its rates should be reduced.

It is perhaps appropriate to point out: First, that the general statement that freight is carried cheaper in America than in any other country except India is incorrect. It is one of those examples in which statistics lie. The statement is often made that where our cost of carrying is about $7\frac{3}{4}$ mills per ton-mile in average for the entire country, it is, say, in England (before the war), 22 mills; but the fact is that this $7\frac{3}{4}$ mills per ton-mile in average is arrived at by including all the

Mr. Bernhard.

freight, 60% of which is agricultural, forest, and mineral products, a very large percentage of such products being moved in France, England (coastwise), Holland, Germany, etc., by water, and, because these low-paying commodities have been left out of their average, such average cost of freight carrying seems to be higher. If, however, we eliminate these three products from the total freight carried, and then ascertain the average for the remaining products, we will have entirely different figures to compare.

Second, it is equally incorrect to state that in the only place in America where the railroads are governmentally owned, the rate, in cents, is more than the average for the privately owned railroads, in mills. The road referred to is, of course, that in Alaska. The question is, what would the rates have been, under private ownership, of a road working under the existing conditions in such a sparsely settled community? The only fair comparison would be with the cost in New Mexico, and even that would be very much in favor of the New Mexico lines, because they at least can operate the year round without snow interference.

Third, the idea advanced by Mr. Smith, on public ownership but private operation of tracks and terminals, has been followed in Holland for many decades, and has worked very satisfactorily.

Mr. Ray.

G. J. Ray,* M. Am. Soc. C. E.—Mr. Smith seems to know something about the Delaware, Lackawanna and Western Railroad and the Central Railroad of New Jersey. If he lived along the Lackawanna and had looked into the charter of the old Morris and Essex Railroad, he would have found that he has the right to get a buggy, with proper gauge, and, if he complies with the rules and regulations of the road, run his buggy over the Lackawanna as he desires, for the charter of that road, one of the first railroads built in New Jersey, and one of the first in the country, provided that any citizen of the State should have the right to run his buggy over the railroad between Newark and Morristown. He could go on the tracks at any crossing, so long as his buggy was of the proper gauge, if he lived up to the operating rules and regulations of the railroad.

The trouble is that most of our citizens do not want to look up the facts, and do not want to live up to the obligations after they find out what the facts are.

Most of the railroads, especially around New York City, are endeavoring to give the public good service, and have been succeeding fairly well. The speaker believes that if Mr. Bernhard would further analyze the rates in the case he cites, he would find that the salt that went from Syracuse to Baltimore, from Baltimore to New Orleans, and from New Orleans back to St. Louis, was carried at a less rate than

* New York City.

it would cost to ship the same salt by rail a distance of from 100 to 200 miles in Germany. Certainly, if all the facts were given consideration, he would not compare the railroad rates in the United States with those of Germany, and, as far as that is concerned, we are doing business here in America now and not in Germany. Mr. Ray.

There was one point of Mr. Stuart's paper, brought out by Mr. Kittredge, that might be considered a little further, and that is the control of unproductive expenditures required by the public. During the last 10 or 15 years, the railroad with which the speaker has been connected has been spending a lot of money for the purpose of eliminating grade crossings, as well as otherwise improving its line.

Little does the public realize how expensive the commuter business is for a railroad that is so unfortunate as to have to take care of it. That may seem like a more or less ridiculous statement, but an analysis of the facts will show that the railroad that has to take care of a large commuting business, to and from a large center like New York City, has a very serious problem to handle. Where such an immense amount of business is concentrated, especially during such times as we have experienced in the past two or three years, where the capacity of the roads and the shipping facilities have been taxed to the limit, the commuting business is a very grave problem.

The plant required for such a business is necessarily large, compared with the return, and if one considers the total money spent for equipment, terminals, suburban stations, and other expensive improvements, which are necessary in connection with suburban stations, such as grade crossing elimination work, street diversions, drainage, and sewers, which are always more or less serious problems, it will be found to be very expensive.

It takes an immense quantity of equipment, motive power, and cars. The motive power and cars lie idle for the greater portion of the day, for they are used for only two or three hours in the morning and for about the same length of time in the evening. Furthermore, the staff of employees must be sufficient to operate the maximum number of trains. These employees must be paid a minimum wage, and, from an operating standpoint, it is often a difficult matter to use the men to advantage throughout the greater part of the day.

In many cases the suburban business greatly interferes with handling freight to and from the terminals. It cannot be delayed on account of the freight business, and this adds to the cost and increases the delay in handling the freight.

All things considered, as a rule, it is not a very lucrative business, and is one about which the officers and management are criticised almost every day. Honest criticism is all right, and sometimes is productive of good, but, as a rule, the commuter has but little knowledge of the

Mr. Ray. many problems involved, nor does he fully realize the very heavy expenses connected with it.

In rebuilding the stations and eliminating grade crossings in suburban districts, it is usually difficult to satisfy the local commuter and finally convince the people that they are getting the best that has ever been built. Therefore, such improvements are very expensive and bring very little return. As Mr. Kittredge stated, scarcely one additional commuter can be traced to such improvements.

The speaker believes this to be one of the cases in which there ought to be some definite method of controlling expenditures and providing the necessary funds to pay for the improvements, whether through rates or a proper allocation of the expenses.

Mr. Keith. HERBERT C. KEITH,* M. AM. SOC. C. E.—At present much is heard about conservation, a subject deserving the best thought of all men; but much that poses under that name in the Government operation of railroads reminds one of Aesop's fable of the boys stoning the frogs. It may be fun for the Railroad Administration, but it comes too near being fatal to the traveling public.

When Mr. Brandeis, now Justice of the Supreme Court of the United States, stated that the railroads of this country could save a million dollars a day by the adoption of such methods as holding trains until sufficient cars—passenger or freight—were filled to make a train using the full capacity of the locomotive, and running the same at such speed as to procure the maximum hauling capacity of the coal, water, etc., consumed, probably few supposed him to be in earnest. Probably no one believed that the public would put up with the inconvenience such methods would entail; but, under the stress of war, the Government has adopted approximately those very methods, making some saving to the railroads (or their administration), but putting the public to an increased expense of many times the saving to the roads. With the duress of war removed, it is not probable that the public would submit long to such an abuse, whether under Government or private ownership or control.

The number of city railroad ticket offices in Greater New York was reduced to five, requiring a large amount of intra-city travel by the public in order to purchase tickets or to engage accommodations. Even in those five offices the number of employees was reduced to such an extent that the traveler had to stand in line a long time before receiving attention. When purchased, the tickets were good only for the day of purchase; and the sale of mileage books became simply the taking of the purchaser's money by the Railroad Administration in advance, with no benefit to the purchaser, either in cash discount or the saving of later inconvenience; for an exchange of the mileage coupons for the regular

* New York City.

passage ticket was required when one was to travel, and at the same price. Mr. Keith.

The new brand of railroad conservation has been shown, also, in scanty maintenance work, both in way and equipment, so that large expenditures must be made soon, or there will be increased expense, delay, and trouble. Only slightly more than half the normal quantity of rails, ties, and other track material was used in renewals in 1918; stations and other facilities were allowed to get badly out of repair, and almost nothing was done in the way of bridge renewals or repairs. A large number of locomotives and cars were purchased; however, they were not credited to maintenance, but charged to the railroad companies as improvements, though, to a large extent, they were misfits for the different railroads, because the microbe of standardization has attacked the Administration and has led to the purchase of the same kind of rolling stock for mountain roads as for those that have spent millions of dollars to reduce their grades to less than one-half of 1 per cent.

In spite of all this scantiness of expenditure for maintenance of way and equipment, operating expenses have increased 40% above those of the previous year, and the traffic has been substantially the same. This increase of expenditure was due largely to increases in wages of those employees organized in the labor unions, and to the high cost of material and general supplies. Executives, engineers, and other technical men have had no share in this increase, but rather have been dropped, or have had their salaries reduced or thrown on the railroad companies (in distinction from the U. S. Administration), under the plea that their work concerned the conservation of property rather than the operation of the roads. It is amazing that the cost of such work as the preservation of the title to real estate, reports to and meetings of the stockholders, legal expenses connected with the property, and its valuation as required for the Interstate Commerce Commission, was included in the operating expense in the years on which the compensation to the security holders was based, but such charges were not allowed as operating expenses when making payment—or the promise of such—for the actual use of the property.

The agreements made by the Government with the railroad companies call for the return of the property, at the expiration of the period of Government operation, in the same condition as it was received. If this is done, it will require, before that time, for the maintenance of way and equipment, the expenditure of a larger sum of money than the $500 000 000 "Revolving Fund" already used up in the operation.

For years the railroads have been asking permission to make a small increase in rates, but were refused because the Interstate Commerce Commission denied the necessity for such increase to provide a reasonable return on the investment of the stock- and bond-holders. At the

Mr. Keith.

same time the Labor Boards awarded increase after increase of wages. A short time before the Government took the roads, a small increase in rates was granted, but this was too late to affect materially the earnings for the period used as the basis for the return to be paid by the Government to the owners for the use of their property. Soon after the U. S. Administration took charge, passenger and freight rates were increased, so that receipts for 1918, for approximately the same amount of business, increased 22% above those for the previous year, but, in spite of this, because of the increased expenses, as previously stated, the net earnings were reduced to such an extent that the $500 000 000 "Revolving Fund" is exhausted, and the Administration asks for an additional $750 000 000 to make up the deficit of what is required to be paid to the railroad companies according to the agreements—even as the Director General himself interprets them.

Demand is now made for five years' continuance of Government operation, because the time has been too short to determine the advisability of Government ownership. One naturally asks "Were the railroads taken for the purpose of aiding in prosecuting the war, or was that only camouflage to conceal Government ownership?"

The subject of rates has been mentioned. It is a very interesting fact that, before the war, in normal times, the railroad companies of the United States paid higher wages and salaries than any other country in the world, while, at the same time, the railroads of this country gave cheaper transportation and better service for both passengers and freight than any in the world, with the exception of India, where rates were a trifle lower, but where the pay of laborers was hardly more in cents than it was in dollars in the United States. It is an interesting fact that on the only Government-owned railroad of the United States, prior to the war, the freight rates were more, expressed in cents per ton, than the average of those of the privately owned railroads of the country, expressed in mills.

In connection with Mr. Ray's remarks about the rights of the Delaware, Lackawanna and Western Railroad, it is interesting to note that the charter of the Boston and Lowell Railroad, granted June 5th, 1830, authorized the company to erect toll-gates at any and all points where it might desire, and to collect the tolls thereat, evidently with the idea that anybody could harness his horse or mule to his car and use it on the railroad. Just before the bill received its third and final reading, an amendment was made, providing that, in case the experiment then being conducted in England should prove successful, the railroad might use steam.

struction work than in any other period of its history, and many of its prominent public works are monuments to his skill and professional ability. It was under his administration and supervision that the great harbor belt-line project was started and completed, the chain of old public school buildings replaced by modern structures, the street paving throughout the city brought up to metropolitan standards, including a municipal repair plant, and many of the public parks and playgrounds created. Notable among these improvements is the sea wall and park at West End, which was designed and constructed under his direction.

Capt. Hardee died after a brief illness resulting from epidemical influenza. His life had been devoted to his profession in which he had attained a place of distinction and national prominence. He was a veteran of the Spanish-American War, having volunteered for service at the outbreak of those hostilities, and was commissioned by President McKinley, Captain of Company F, Third Regiment, U. S. Volunteer Engineers.

Capt. Hardee was a Member of the Louisiana State Society of Engineers, and of the National Association of City Engineers. He was twice President of the latter Association, and at the time of his death was an Honorary Vice-President of the organization. He was elected a Member of the American Society of Civil Engineers on May 6th, 1896, and was the oldest New Orleans member of the Society.

## CHARLES JOHN AUGUSTUS MORRIS, M. Am. Soc. C. E.*

DIED OCTOBER 28TH, 1918.

Charles John Augustus Morris, the son of Charles A. F. and Mary Ellen Morris (*nee* Lane), was born in Brooklyn, N. Y., on July 26th, 1850.

His early education was obtained in public and private schools, his professional education and training being acquired later under the tutorage of his father, a graduate of Dublin University and a prominent and experienced civil engineer and contractor, who, for many years, was one of the leading pioneer civil engineers in railway construction work in the earlier days of the Northwestern States.

So far as can be learned, the first important engineering work performed by Charles John Augustus Morris consisted of the survey and location, in 1871, of an extension of the St. Paul and Pacific Railroad from a point now occupied by Barnesville, Minn., to St. Vincent, on the northern boundary of the State. In 1875 and 1876, Mr. Morris was similarly engaged on surveys for the St. Paul and Pacific Railroad in the western part of Minnesota.

* Memoir prepared by William de la Barre, M. Am. Soc. C. E.

In 1878, he was engaged on Government work at Rock Island, Ill., and, during 1879, was employed in the United States Government Engineer's office in St. Paul, Minn., under Maj. Allen, of the U. S. Corps of Engineers. In 1880, Mr. Morris had charge of the construction of a water-power canal for the Pillsbury "A" Mill, at the Falls of St. Anthony, in Minneapolis, Minn.

In 1881, he was employed by the St. Paul, Minneapolis and Manitoba Railway Company on bridge, trackage, and other construction work, and in 1882, 1883, and part of 1884, he made the surveys and located the present Stone Arch Bridge across the Mississippi River, for the Minneapolis Union Railway Company. During the construction of this noteworthy bridge, he was the Supervising Engineer in charge, the Chief Engineer being the late Col. C. C. Smith, M. Am. Soc. C. E., of the Great Northern Railway Company. During this period Mr. Morris was also in charge of the re-arrangement of trackage for the new Union Station in Minneapolis and the construction of the buildings forming that station; he remained in the employ of the Great Northern Railway Company until 1887.

From 1888 to 1890, Mr. Morris was a member of the contracting firm of McMullen and Morris, engaged in heavy masonry work, particularly in constructing large retaining walls in St. Paul and Minneapolis in connection with the lowering of track grades. During this time, he also had charge of the work of erecting the foundation piers for the High Bridge in St. Paul.

On March 22d, 1888, he was appointed Chief Engineer of the St. Paul and Duluth Railway Company, and continued in that position until June 15th, 1890, at which time the property was taken over by the Northern Pacific Railway Company. Mr. Morris then entered the construction field as a member of the firm of Frankman Brothers and Morris.

During 1891 and 1892, he was Chief Engineer of the Minneapolis Western Railway Company, having charge, among other matters, of the design, construction, and erection of the steel railway bridge over the Mississippi River immediately below the Falls of St. Anthony. During this period he also acted as Consulting Engineer for the Northwestern Fuel Company in connection with the design and construction of its coal dock substructure at Superior, Wis. The firm of Frankman Brothers and Morris also constructed the timber cribbing and timber coal bins of Section No. 1 of the Northwestern Fuel Company's Superior Dock No. 1 on Connor's Point, as well as the timber cribbing for the Company's Coal Dock No. 2 on St. Louis Bay, near Duluth.

From September, 1895, to January, 1898, Mr. Morris was engaged in superintending the construction of the St. Anthony Falls Water-power Company's lower dam and power house, including the hydro-electric development of 10 000 h. p., below the Falls of St. Anthony.

From 1900 to 1904, he was actively employed in various engineering and construction works at the head of Lake Superior, particularly at Duluth, Two Harbors, and Superior, as Chief Engineer of companies handling coal and iron ore, continuing in that capacity until the Northwestern Fuel Company's property was acquired by the Pittsburgh Coal Company. It was under his direction and superintendence, that the first hydraulic dredge on the Great Lakes was constructed and put in operation. During this period he designed and supervised the construction of Dock No. 5, at Duluth, for the Pittsburgh Coal Company, with a storage space of 400 by 1 000 ft. with forty stationary hoists. Later, this storage space was lengthened to 1 360 ft., and four movable hoists were added to the equipment. In 1906, the firm of Frankman Brothers and Morris constructed the timber cribbing and anthracite storage building, of 2 000 000 tons storage capacity, on Section No. 2 of the Northwestern Fuel Company's Dock No. 1 at Superior, Wis.

From July, 1907, to June, 1908, Frankman Brothers and Morris was engaged in the erection, for the Northern Pacific Railway Company, of its Valley City, N. Dak., viaduct, which is one of the largest and heaviest viaducts in the Northwest, being about 3 000 ft. long and 150 ft. high, with double-track towers and substructures, the erection of which covered the placing of more than 7 000 tons of steel.

In 1907, Mr. Morris was also employed as Consulting Engineer and had charge of the construction of Dock No. 1 of the Berwind Fuel Company at Superior, Wis., and, at about this period, he was also engaged in the construction of additional dock facilities at both Superior and Duluth.

In 1909 he became the senior partner of the contracting firm of Morris and Shepard (changed in 1912 to Morris, Shepard and Dougherty), which firm was subsequently engaged in various railway construction work for the Chicago, Milwaukee and St. Paul Railway Company, the Chicago, Burlington and Quincy Railway Company, and the Great Northern and Northern Pacific Railway Companies and, in addition, in dock construction work at the head of the Lakes.

At the time of his death, the firm of Morris and Dougherty (Mr. Shepard having retired) and the George J. Grant Construction Company had the contract with the Union Depot Company of St. Paul, Minn., for the design and construction of the new Union Station in that city and the building of the various adjacent yard systems connected therewith.

Mr. Morris was married, on December 31st, 1878, at Cleveland, Ohio, to Sarah R. Saunders, who survives him; other surviving relatives are two brothers and two sisters.

He was a member of the Civil Engineers Club of St. Paul, Minn., Minnesota Club, St. Paul Athletic Club, University Club, and Town and Country Club, all of the same city.

Mr. Morris was a gentleman with whom it was a genuine pleasure to be acquainted and associated. His ideals were always of the highest character, and, equally as a friend or business associate, he was thoroughly faithful, conscientious, and reliable, and was held in high esteem by employer and employee alike. He was energetic and resourceful to a high degree, and his ability as an engineer, together with his pleasing and tactful personality, contributed largely in insuring the success of his business life.

Mr. Morris was elected a Member of the American Society of Civil Engineers on October 3d, 1883.

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## JOHN HULL DECKER, Assoc. M. Am. Soc. C. E.*

DIED OCTOBER 10TH, 1918.

John Hull Decker was born in Sioux City, Iowa, on September 25th, 1878. The family moved to Brooklyn, N. Y., where Mr. Decker attended the public schools, and was graduated from the Manual Training High School in 1898. During the summers of 1895, 1896, and 1897 he was employed in the shops of the Thomson Meter Company, of Brooklyn, assisting in experiments on water meters, and, in 1898, he took up the study of surveying in the office of Mr. Charles Crook, of Brooklyn, and afterward with Mr. R. L. Williams, of the same place, first, as Rodman and then as Instrumentman. In January, 1900, he entered the employ of Richard Lamb, M. Am. Soc. C. E., of New York City, and was in responsible charge of topographical surveys for electric railways, water mains, sewers, and road construction, and assisted in the design and construction of a copper mining plant.

Throughout 1901, Mr. Decker was with the Babcock and Wilcox Company, of Bayonne, N. J., as Draftsman on water-tube boilers, Inspector on the erection of factory buildings, and Engineer, Inspector, and Surveyor on switch-yard work.

In January, 1902, he entered the employ of the Atlantic City Sewerage Company, Atlantic City, N. J., as Engineer on construction for three months and then as Superintendent and Engineer of the company, having responsible charge of the design, construction, and maintenance of the sewerage system, involving re-designing, enlarging, and reconstructing the system, comprising about 50 miles of pipe sewers.

From January, 1906, until his death, Mr. Decker was Engineer and General Manager of the Atlantic Construction and Supply Company, of Atlantic City, engaged in general contracting, particularly of sewerage systems, water-works, highway construction, and reinforced

* Memoir prepared by F. Herbert Snow, M. Am. Soc. C. E.

concrete work. His work as Contractor in the erection of the new electric light power plant at Atlantic City attracted favorable attention. He also built the new Somers Point-Longport Boulevard. Probably his most notable work, apart from that of rebuilding the Atlantic City sewerage system, was done in connection with T. Chalkley Hatton, M. Am. Soc. C. E., on the design and construction of the Atlantic City drainage canal.

Mr. Decker was a self-made man and engineer, well known all over South Jersey and in many other communities. He was affable and whole-souled, and his friendship was valued. Although cut off in the prime of life, and at a time when the business for which he had struggled had become well established, and with bright prospects ahead, he left an estate that will provide confortably for his widow and child.

Mr. Decker was elected a Junior of the American Society of Civil Engineers on September 6th, 1904, and an Associate Member on December 5th, 1906.

## CLARENCE FREDERICK EBERLY, Assoc. M. Am. Soc. C. E.*

DIED DECEMBER 18TH, 1918.

Clarence Frederick Eberly was born at Perrysburg, Ohio, on November 30th, 1882. He received his early education in the grade and high schools of Perrysburg, and, on his graduation from Ohio State University in June, 1906, entered the service of the United States Government as Junior Topographer in the United States Geological Survey; he remained in the Survey Service until November, 1912. During Mr. Eberly's connection with that department he had charge of various work, including the mapping of 225 sq. miles in West Virginia, making topographic surveys in Idaho and Arizona, the making of a map of Seattle for the Alaska-Yukon and Pacific Exposition, besides considerable office work which was done at the headquarters of the Survey, in Washington, D. C.

Mr. Eberly left the Survey Service in November, 1912, to help take charge of the establishing of a geographical survey department for the Argentine Republic, but only spent one year in Argentine, returning in December, 1913, to the United States Geological Survey.

Mr. Eberly left the Survey again in April, 1914, to engage in a real estate and building proposition as Secretary of The Heffelbower Realty Company, of Toledo, Ohio. After successfully putting through this venture, he joined the staff of the Lucas County Surveyor, in May, 1917, as Senior Engineer, in charge of highway surveys and construction, but, in July, 1918, obtained a leave of absence in order

* Memoir prepared by Cecil L. Rood, Esq.

to render what aid he could in the construction of the Government air-nitrates plant, then building in Toledo. On this work he had charge of the construction of streets and highways, and, by his untiring efforts and ability, rendered valuable service. He left the nitrates plant in September in order that he might be able to donate his services to the Government as Instructor of Field Engineering at the Toledo University for the Student Army Training Corps, and was engaged in this work at the time of his death. While instructing his class he was stricken with an attack of influenza which in three days developed into pneumonia, from which he died in less than one week, on December 18th, 1918.

He was unmarried, and leaves, besides his father and mother, Mr. and Mrs. F. C. Eberly, of Perrysburg, Ohio, two brothers: Somers L. Eberly, of Toledo, and Capt. Karl C. Eberly, of the American Expeditionary Forces in France.

Mr. Eberly was a member of Phœnix Lodge, No. 123, F. and A. M., a member of the Kappa Sigma Fraternity, and was elected an Associate Member of the American Society of Civil Engineers on September 6th, 1910.

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## RALPH RICHARDSON MARRIAN, Jun. Am. Soc. C. E.*

DIED OCTOBER 17TH, 1918.

Ralph Richardson Marrian was born at Watertown, N. Y., on March 24th, 1890. He received his early education in the Watertown schools, and then attended Cornell University, from which he was graduated with the degree of Civil Engineer in 1915.

During the summer of 1914 Mr. Marrian was a Transitman in the Engineering Department of the New York Central Railroad, and, in June, 1915, was employed by Messrs. Hazen, Whipple and Fuller, in New York City. While so engaged, he enlisted in the Seventh New York Infantry, and, in the summer and fall of 1916, served with that regiment on the Mexican border. On the return of the regiment, he was discharged.

When the United States entered the war, Mr. Marrian re-enlisted and received a commission as Second Lieutenant. After two months of training at Camp American University, in Washington, D. C., he was assigned to the 105th U. S. Engineers, then stationed at Camp Sevier, Greenville, S. C. In May, 1918, he went overseas with that regiment, and soon afterward was promoted to the rank of First Lieutenant.

* Memoir prepared by Woodford Patterson, Esq.

Lieut. Marrian was wounded on October 17th, 1918, by a bursting shell while repairing roads under shell fire near Molain, northeast of Bohain, in France, in order that artillery might follow up an infantry drive. A shell burst near him and his men, killing two outright and wounding four besides himself. He died soon after he was carried to the main dressing station, and was buried in the Military Cemetery at Montbrehain, where his company built a fence around the grave and placed a cross at its head.

Col. Joseph Hyde Pratt, commanding the 105th Engineers, in reporting his death to his family, wrote that Lieut. Marrian had been doing splendid service, and added: "He was brave, conscientious, and a good leader. He had the confidence of his men, and he and they gave the best they had for their country."

Lieut. Marrian was elected a Junior of the American Society of Civil Engineers on April 18th, 1916.

## PAPERS IN THIS NUMBER

"ON A NEW PRINCIPLE IN THE THEORY OF STRUCTURES." GEORGE F. SWAIN.

"THE EAST CANYON CREEK DAM." A. F. PARKER. (To be presented May 7th, 1919.)

## PAPERS AND DISCUSSIONS CURRENT IN PROCEEDINGS

**"Cement Joints for Cast-Iron Water Mains."** CLARK H. SHAW.....Mar., 1917
Discussion.....May, Aug., "

**Progress Report of the Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, etc.**.....Aug., "
Discussion.....Nov., "

**Final Report of the Special Committee on Steel Columns and Struts**.....Dec., "
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# PROCEEDINGS

OF THE

# AMERICAN SOCIETY

OF

# CIVIL ENGINEERS

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April, 1919

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OF THE

# AMERICAN SOCIETY

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(INSTITUTED 1852)

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APRIL, 1919

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ON THE REGULATION OF WATER RIGHTS: F. H. Newell, W. C. Hoad, John H. Lewis.

TO REPORT ON STRESSES IN RAILROAD TRACK: A. N. Talbot, A. S. Baldwin, G. H. Bremner, John Brunner, W. J. Burton, Charles S. Churchill, W. C. Cushing, Robert W. Hunt, George W. Kittredge, Paul M. LaBach, C. G. E. Larsson, G. J. Ray, Albert F. Reichmann, H. R. Safford, F. E. Turneaure, J. E. Willoughby.

The Reading Room of the Society is open from 9 A. M. to 10 P. M. every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day; during July and August, it is closed at 6 P. M.

HEADQUARTERS OF THE SOCIETY—33 WEST THIRTY-NINTH STREET, NEW YORK.

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Vol. XLV. APRIL, 1919. No. 4.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852.

# PROCEEDINGS

This Society is not responsible for any statement made or opinion expressed in its publications.

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## MINUTES OF MEETINGS OF THE SOCIETY

**March 19th, 1919.**—The meeting was called to order at 8.30 P. M.; Vice-President Nelson P. Lewis in the chair; Chas. Warren Hunt, Secretary; and present, also, 305 members and guests.

The meeting was devoted to a discussion of the New York and New Jersey Vehicular Tunnel. E. A. Byrne, M. Am. Soc. C. E., Chief Engineer of the Department of Plant and Structures of New York City, and also Consulting Engineer for the New York and New Jersey Tunnel Commission, opened the discussion, illustrating his remarks with lantern slides. The subject was discussed by Messrs. John F. O'Rourke, Paul G. Brown, J. V. Davies, James Forgie, Walter C. Parmley, T. Kennard Thomson, F. Lavis, Calvin Tomkins, Charles Evan Fowler, and George D. Snyder.

The Secretary announced the election of the following candidate on March 11th, 1919:

As Members

Henry Keepers Babbitt, Pompton Lakes, N. J.
Bion Angelo Bowman, Boston, Mass.
Harvey Courtright Brice, New Westminster, B. C., Canada
Edward Fairbank Carter, Melbourne, Victoria, Australia
Edward Charles Epple, Newark, N. J.
Frederick Anson Ericson, Nutley, N. J.
James Linwood Fawley, Philadelphia, Pa.
Ralph Freeman, London, England
Hans Jorgen Hansen, Chicago, Ill.
Thomas Arthur Jordan, Los Angeles, Cal.
Moses Leland Kingsley, Chicago, Ill.
Bernhard Martin Samuelson, Rangoon, India
Lewis Malcolm Stoddard, Jacksonville, Fla.
John Terrell Vawter, Philadelphia, Pa.
Wilmot Edgar Whittier, El Paso, Tex.
Roland Woodward, Jacksonville, Fla.

As Associate Members

Arthur Henry Abel, Portland, Ore.
Herbert Sidney Austin, Muskogee, Okla.
Charles Stewart Babb, Chicago, Ill.
Rufus McClellan Beanfield, Philadelphia, Pa.
Guy Bonney, Baltimore, Md.
Edmund Potts Burke, Detroit, Mich.
Dyer Butterfield, Chattanooga, Tenn.
Robert Stewart Calland, Yakima, Wash.
Charles Bloomfield Carman, Metuchen, N. J.
Jermain Chandler, Toledo, Ohio
Ronald Farquhar Chapman, Staines, England
Edgar Cockroft, San Diego, Cal.
Clyde Daniel Coffman, Washington, D. C.
John Lambert Collins, Lowell, Mass.
James Oscar Convill, Portland, Ore.
Daniel Chauncey Corwin, Norfolk, Va.
William Nathaniel Cramer, Chicago, Ill.
Hervey Kinch Doane, Miles City, Mont.
Anderson Edward Duckwall, Scottdale, Pa.
Frank Clarke Dugan, Washington, D. C.
Leyburn Grier Fishach, Sewickley, Pa.
Arnold Groothoff, Bandoeng, Java
Cuthbert Wead Haasis, Kensington, Ohio

Joseph Newcom Henderson, Kittanning, Pa.
Milton Hesselberger, Los Angeles, Cal.
William Clarence Hight, Walnut Ridge, Ark.
William Deloney Hull, Jacksonville, Fla.
Robert Olen Jameson, Dallas, Tex.
Charles Miller Jervis, Cupey, Oriente, Cuba
Lasley Lee, Tacoma, Wash.
Edward Searles Lindley, Bombay, India
Reynolds McHenry, San Francisco, Cal.
Leslie Ono Marden, Hampton, Va.
James Philip Nash, Austin, Tex.
Homer George Olmsted, Kansas City, Mo.
Wilbur Corthell Otis, Boston, Mass.
Frank Edison Richardson, Okmulgee, Okla.
Sanford Wales Sawin, Wilmington, Del.
Roscoe Lee Smith, Washington, D. C.
Lloyd Lawrence Stanley, Washington, D. C.
Warren Dudley Trask, Somerville, Mass.
James Tyler, Auckland, New Zealand
Arthur Tyndall, Trentham Military Camp, New Zealand
Cowles Mead Vaiden, Edgewood, Md.
William Edward Woolley, London, England
Thomas Parks Wright, Atlanta, Ga.

As Associates

Fred Rudolf Schmidt, Denver, Colo.

As Juniors

Bernard Edward Baer, Fort Leavenworth, Kans.
Moacyr Rodrigues Dias, São Paulo, Brazil
William Louis Hanselman, Montclair, N. J.
Isaac William Pugh, Baltimore, Md.
Albert Michael Tietzel, Johnstown, Pa.
Jorge Triana, Bogota, Colombia
Cornelius Van Eenenaam, Belleville, Ill.

The Secretary announced the transfer of the following candidates on March 11th, 1919:

From Associate Member to Member

Frederick Louis Bixby, Reno, Nev.
Haig Milton Boyajohn, Hog Island, Pa.
Harold Dearborn Comstock, Riverton, Wyo.
Gilbert Colfax Dobson, Washington, D. C.
Russell de Costa Greene, New York City

Winfred Miller Kallasch, Chicago, Ill.
Christopher George Morrison, Juneau, Alaska
William Edmund Price, Camp Hancock, Ga.
Walter Jackman Ryan, Camp A. A. Humphreys, Va.
William Hatfield Sears, Chattanooga, Tenn.
Ralph Graham Shankland, Chicago, Ill.
Maurice Joseph Sullivan, Houston, Tex.
Charles Winthrop Tarr, Windsor, Ont., Canada

From Junior to Associate Member

Robert Sumter Anderson, Tulsa, Okla.
Raymond Wenthworth Brooks, Kansas City, Mo.
Emerson Lawrence Chandler, Dayton, Ohio
Horace Kellogg Corbin, New York City
Ralph Edmund Drake, Barberton, Ohio
Searle Brown Nevius, Oakland, Cal.
Kenneth Hammet Talbot, Pittsburgh, Pa.
William Floyd Way, Am. Exp. Forces, France
David Ewing White, Chicago, Ill.
Harold Cushing Whitmore, Lynn, Mass.
Jick Gam Wong, Tsaoshih, China

The Secretary announced the following deaths:

Ralph Henry Brown, of Worcester, Mass., elected Member, June 7th, 1899; died February 22d, 1919.

James Nisbet Hazlehurst, Maj., Engrs., U. S. A., of Atlanta, Ga., elected Member, October 4th, 1899; died in service (France), February 9th, 1919.

Norman Marshall Halcombe, Maj., Royal Flying Corps, British Army, of San Francisco, Cal., elected Junior, September 3d, 1907; Associate Member, May 2d, 1911; died in service (Port Said, Egypt), February 15th, 1919.

Adjourned.

**April 2d, 1919.**—The meeting was called to order at 8.30 p. m.; President F. S. Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, 130 members and guests.

The minutes of the meetings of February 19th and March 5th, 1919, were approved as printed in *Proceedings* for March, 1919.

Col. Dabney H. Maury, U. S. A., M. Am. Soc. C. E., Advisory Engineer on Water Supply, Construction Division, War Department, addressed the meeting on "Water Supply at Camps and Cantonments and Other Government Enterprises", illustrating his remarks with lantern slides.

The subject was discussed by Messrs. George W. Fuller, Paul H. Norcross, Clarence Goldsmith, T. Kennard Thomson, William P. Mason, J. Waldo Smith, E. T. Thurston, K. M. Boorman, W. J. Boucher, Morris Knowles, and Col. Maury.

The Secretary announced the following deaths:

Harvey Mosher Geer, of Ballston, N. Y., elected Member, June 6th, 1894; died March 18th, 1919.

George M. Stevens, of Roxbury, Mass., elected Associate Member, November 6th, 1907; died September, 1918.

Adjourned.

# THE ENGINEER IN HIS RELATION TO ADMINISTRATION

Address by Nelson P. Lewis, M. Am. Soc. C. E.,
At an Engineers' Symposium
Held in the Engineering Societies Building,
New York City, March 26th, 1919.

What do we mean by administration? Heads of great industrial enterprises, transportation companies, and all other public service activities are required to perform functions which are largely administrative. Such places were once almost always filled by business men or lawyers; later, by men who had come up from the ranks, hard-headed men who had begun as boys and passed through the various branches or divisions of the work and had demonstrated qualities of leadership and executive capacity, but seldom were they men of technical education. During recent years we have seen such places more frequently filled by men who knew the science as well as the art of the business, keeping in mind the old distinction between the two, namely, that science teaches us to know and art to do. Men of the older type may have been able to do, but they frequently were more or less ignorant as to the why of the doing. They felt that they were able to secure all the technical advice they required and pay for it at the prevailing rate, often far less than it was worth. The man who knows the why of the doing and at the same time has the capacity to do and can make others realize that he both knows and can do, however, has a great advantage in the race for leadership in administrative work. There have been many conspicuous instances where spectacular success has been achieved by young men of this type, a success which would only have been gained under the former system through long service beginning at the very bottom and slowly mastering the details.

The term administration, as commonly used and understood, however, relates more particularly to public business, business of the city, state and nation. From this type of administration, the Engineer has been more completely excluded than in the case of industrial concerns or public service corporations. But what is the city or state but a public service corporation? In this exclusion the Engineer himself has appeared to acquiesce. To repeat words which heretofore I have used several times, the Engineer has been so long accustomed to doing things when he is told, as he is told, and because he is told by those whose function he has thought it to be to determine general plans and policies, that he is in no small degree responsible for the idea which has been generally prevalent, that the duty of the Engineer is simply to carry out the ideas and policies of others. But if it be admitted, as it must, that what is commonly called the administration of public business is largely the formulation and execution of engineer-

ing projects, why should not engineers themselves take a conspicuous part in their formulation as well as their execution?

There has been a growing appreciation of the importance of engineering advice in public business, and large technical staffs have been created for the study of plans and the execution of work, while engineering advice has been more and more sought and followed in the formulation of policies. And then there has often been a reaction, following the realization that the city, the state, or the nation is being governed to an unduly large degree by engineers and it has been thought wise and necessary to show them their places. But, after some unfortunate experiences and some bad bungling, resulting in considerable waste of public funds through the adoption of ill-considered and unrelated plans, a new cycle has been begun, and the engineers have again come to the front, and each time they have gone a little farther in the extent and importance of the service rendered.

The machinery of municipal administration, as prescribed by city charters, has usually been very cumbersome and ill adapted to meet emergent conditions. In 1900 the City of Galveston, Tex., was practically wrecked by a violent storm and tidal wave. The city was already in a bad financial condition, and the municipal government was unable to cope with the situation. The various departments and bureaus were paralyzed and, in order to meet existing conditions, a form of commission government was adopted under which the entire management of the city's affairs was placed in the hands of five men. One of these had the title of Mayor, although his duties and powers differed little from those of his colleagues, to each of whom specific functions were assigned. So successful was the plan that within a dozen years it had been adopted by about 400 cities and towns within the United States.

In 1913 the City of Dayton, Ohio, went a step farther and adopted what is known as the Commission-Manager plan. This also consisted of a commission of five citizens, elected at large, who constituted the governing body, but they appoint a chief administrative officer, designated as the City Manager. It will be noted that these two forward steps in municipal government were taken by cities which had suffered great disasters. It is true that at Dayton the idea had been under consideration before the flood which occurred about that time, but the ready adoption of the City Manager plan was probably due to the chaotic conditions resulting from the flood, when, as was the case at Galveston, the city government under its old charter provisions and limitations failed to function satisfactorily.

Thus was developed a field which the engineer with executive capacity is especially well qualified to fill. That this opinion is held by those responsible for the selection of the managing executives is evidenced by an examination of the list of City Managers who have been appointed. There is a City Managers' Association, and from its

Year Book and from information compiled by the *American City Magazine,* it appears that at the beginning of the present year 124 cities and towns in the United States were operating under some form of the City Manager plan. I have been able to secure information as to the previous experience and training of 88 of the managers, thus confirming the statement that a new and important opportunity has been opened to engineers. The classification is as follows:

50 professional engineers
9 merchants
6 minor city officials
5 general business
3 superintendents of construction
2 journalists
13 miscellaneous (These include a contractor, railroad president, railroad purchasing agent, public utility manager, professor of government, student of Training School for Public Service, office manager, league secretary, real estate dealer, lawyer, physician, broker, and plumber.)

It will be seen that where the City Manager plan has been adopted —and the idea has spread very rapidly—the trained engineer has moved up from the position of hired man to that of chief executive, and that the business man and merchant, so often regarded as the only men qualified by experience and training to manage the city's business, even when their numbers are combined, are a bad second, while the lawyer, once so commonly selected to conduct the public business, is, with the real estate man and the plumber, among those who "also ran".

It probably will be conceded that engineers have demonstrated their peculiar fitness for the positions which have been described, but the attention of those responsible for the selection of City Managers might well be called to their availability, and this can very properly be done.

Last year I was asked to serve as chairman of a committee to formulate for the National Municipal League a statement of the qualifications for City Manager and a questionnaire to be sent to all applicants. There were two other members of the committee, one a league secretary and one a director of governmental research. While some concessions had to be made to my colleagues, the statement of qualifications which was unanimously agreed on was as follows:

*Experience.*—Responsible charge of a municipal bureau or department or other actual experience in some branch of municipal work, such as executive, engineering or legal, or an equivalent experience in some administrative or engineering position.

*Education.*—Degree from an engineering school or college; legal training or special study of municipal government are desirable but not essential, provided the candidate shall have demonstrated his capacity by successful performance.

*Personality.*—Capacity to control subordinates and arouse in them enthusiasm for the work to be done; courtesy and tact in relations with the public; firmness, justice, and fairness in conducting the city's business.

*Activities.—Organizations.*—Statement indicating professional or civic organizations of which the applicant is a member, giving in the case of professional organizations the grade of membership, the date of admission, and the name of the secretary or other responsible official of the organization.

*References.*—Not less than three letters from responsible persons familiar with the practical experience of the applicant and setting forth in detail the nature of such experience, its extent, the degree of responsibility involved, and the period covered with dates. Not less than three references as to personal character.

While emphasis was laid on the desirability of engineering training, I would be disposed to go still farther, although admitting there are some others besides professional engineers who doubtless would make acceptable City Managers.

But what about the training of the Engineer to fit him for such positions? Business sense is certainly an essential qualification for success in such work as the management of a city, a public service corporation, or an industrial enterprise. Are the courses given in our engineering schools calculated to fit him for these most attractive fields of activity? We will be told that all the time of the student is required to enable him to cover the strictly technical curriculum, and that if such things as culture and business courses are to be added, the period of training will have to be lengthened or some of the technical courses will have to be curtailed or omitted. Perhaps this would not be as serious a loss as professional educators imagine, while it would broaden the student and might account for the difference between success and failure in administrative positions.

The subject assigned to me was the "Relation of the Engineer to Administration." Perhaps you will think that I have misread it and have discussed "The Engineer as an Administrator." This, however, appears to be a logical sequence of ideas. The concrete suggestions I would leave with you are two:

To those responsible for the selection of men to manage undertakings involving the planning and execution of engineering work, the trained engineer is the logical man for such management.

To those responsible for the early training of engineers, give them a knowledge of business and administrative methods as well as of purely technical subjects.

If the Engineer is to perform his full duty as a citizen, he should not content himself with effort in a restricted technical field, but should be prepared to assume the larger functions involved in the formulation and execution of comprehensive policies as well as plans.

## ITEMS OF INTEREST

### The Engineer as a Citizen

An Engineers' Symposium was held on the evening of March 26th, 1919, in the Auditorium of the Engineering Societies' Building, New York City, under the auspices of the Local Sections of the American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and the Society of Automotive Engineers. Fourteen other engineering organizations, including the American Society of Civil Engineers, were invited to participate. Gano Dunn, Past-President, American Institute of Electrical Engineers, presided. The Auditorium was comfortably filled.

The programme comprised five addresses, all of which were read from manuscript and occupied about 20 min. each in the reading. A general discussion by several of the audience followed.

The first address was by Philip N. Moore, Past-President, American Institute of Mining and Metallurgical Engineers, on "The Civic Responsibilities of the Engineer", during the course of which he said:

"Given like heredity and culture, using the word as distinguished from technical training, there is no inherent reason why an engineer should react differently from any other citizen to the patriotic call or civic responsibility. But, unfortunately, things have combined to leave him too often unwanted and uncalled. What are these things?

"First: Lack of local attachments. The engineer, more than the members of almost any other calling, is always working himself out of a job. With few exceptions, his tasks are scattered country-wide, or world-wide, and mostly are those of construction, which, completed, he goes his way to build again. This is peculiarly true of the civil engineer; it is so of the miner—the sailor of the land. The task of building, always under pressure, is demanding. He works under strain, he has little time to foregather with his fellows, or to think in terms of political or national interest and service, save as great emergencies come, like that of the late war, which take us all from our wonted callings and project us into the vortex of unselfish devotion to national interests. Without local responsibilities, a man feels little sense of civic duty, and finds less opportunity for participation in national questions. Our local attachments are naturally to us the dearest. * * *

"Again, the fact that so large a proportion of the total body of engineers serves the great business consolidations (many of which have interests adverse to the public or by their very size induce criticism and political attack, so that in self defense they think they must hold their staffs to strict neutrality on all public questions), is another reason why so many of the very highest class engineers have perforce been held from civic activity even had they desired otherwise.

"Again, the engineer's training, too often being merely technical, has failed to teach that the greatest task of all is the ability to persuade men, and unwillingness or incapacity to enter public discussions, either through modesty or lack of readiness, has held him back. False

professional pride and the same indifference which holds back many high-class men through unwillingness to mingle with and rub shoulders against the great majority, have deterred him.

"Possibly the past habits of the great organizations which the engineer forms (and which voice his profession) to hold themselves aloof from political affairs as collectively unethical, is another cause.

"These are some of the reasons. Every man before me this evening may have in his innermost heart others equally potent, but the fact remains we have left undone the things which we should have done."

Calvert Townley, Past-Vice-President, American Institute of Electrical Engineers, then read his address on "The Relation of the Engineer to Legislation." After describing various efforts made by committees of engineering societies to assist in forming legislative policies, Mr. Townley closed his address as follows:

"I will feel myself very fortunate if I can interest you to consider what should be the limiting policy of engineers with respect to legislation. It has been my lot to have to do with this question for a number of years and while I have earnestly sought to get the opinions of my engineering friends and to act upon them, I confess that I do not know what engineers want and therefore what our policy should actually be. Of course we believe in ourselves. We believe that an engineer's training, designed as it is to make him think clearly, to deal with essential facts, and to arrive at logical conclusions regardless of outside influence, peculiarly qualifies him to express opinions on legislative as on other subjects, but we shall have to choose which of two places to occupy. Shall we be a united body of technical men speaking only with deliberation and a certain amount of proper dignity regarding subjects which the public recognizes us as qualified to speak upon or shall we be as a body of somewhere from 30 000 to 100 000 citizens who have a common interest and desire to exert political pressure by reason of our numbers?

"I would like to think that we could combine these two positions, but my logic tells me that we cannot. We cannot be a technical organization and a political party at the same time. It should be borne in mind also that sustained effort is what counts. Not much can be accomplished by sitting solemnly in a meeting and passing resolutions. You must get out and hustle—and keep hustling. I assume that no engineer wants to start something which he cannot finish; therefore, an undertaking such as that of convincing our lawmakers to do as we say, should be entered upon only with a full realization of what it means in the way of an outlay of time and also of money. Personally, I have a very strong conviction on one point. It seems obvious that if we dilute our efforts to cover a wide field they must inevitably lose their intensive effect. We should not try to influence legislation which concerns us only as citizens, but if we undertake the task at all, we should concentrate our efforts on certain specific lines and thereby stand a better chance of having them prove effective."

"The Relation of the Engineer to Administration" was the title on the programme of the address by Nelson P. Lewis, Vice-President,

American Society of Civil Engineers. The address will be found on page 414 of this issue of *Proceedings*.

Spencer Miller, Vice-President, American Society of Mechanical Engineers, addressed the meeting on "The Relation of the Engineer to Public Opinion." During the course of his address, Mr. Miller said:

"The engineer is assuming an ever larger position in public life, and, in spite of himself, he is at the very center of life. The more we realize this great truth, the more seriously do we contemplate our responsibilities. This thought fills some with pride and others with humility. Eliminate the engineer from the world, and civilization would soon pass through other 'Dark Ages' comparable with savagery and barbarism. It is clear, therefore, that we, individually and collectively, should make every possible effort to mould public opinion in the right direction, especially at present to counteract the propaganda of those stirring up class hatred. Even to-day the engineer stands, with all law-abiding citizens, facing the dark cloud of Bolshevism—not timidly, not indifferently, but in full strength, courage and faith, that Bolshevism cannot survive in America. Look at Engineer Hoover shooting at Bolshevism. The United States will stand firmly against Bolshevism with bullets and bayonets if necessary, because Bolshevism stands squarely against the code of morals upon which our civilization was founded."

The concluding address was made by Comfort A. Adams, President, American Institute of Electrical Engineers, on "The Relation of the Engineer to Production and Distribution." The following paragraphs formed a part of his remarks:

"Two of three of the speakers have mentioned engineering education, and the last speaker referred to matters of character and spirit. I have been concerned with engineering education for so long that I almost hate to count the years, and certain things during those years have been impressed very vigorously on my mind. One of them is this: It is not the curriculum and the subjects that are taught that count, it is absolutely and solely the way in which they are taught. You can put more spirit and more character-building and more general preparation for citizenship into a course in dynamo design than you will ordinarily be able to find in courses in economics or history or government. That is really a conviction so strong in my mind that I am not concerned with the subjects that are taught, but vastly with the men who teach them. * * *

"Finally, may I for a moment step outside of the strict confines of my subject, and add a plea that we engineers whose normal work is so much concerned with organization in industry, accept as a part of our responsibility as citizens the broader problems relating to the organization of society, that we face the facts fairly and prepare to take an intelligent step forward, rather than wait until the great Tank of Discontent, tired of waiting for us to move, has gained momentum enough to crush us and all that we represent."

**Broader Commercial Education Recommended for Engineers**

The Commissioner of Education, through Dr. Glen Levin Swiggett, Specialist in Commercial Education, invited a committee composed of administrative professors of engineering and commerce from representative higher institutions of learning and delegates from the four National Engineering Societies, to meet in Washington, D. C., at the New Willard Hotel, on March 31st, 1919, to discuss ways and means for the broader education of engineers along commercial lines. There were present twelve prominent educators from well-known technical schools and the following delegates from the National Engineering Societies: American Society of Civil Engineers, Francis R. Weller; American Institute of Mining and Metallurgical Engineers, H. Foster Bain; American Society of Mechanical Engineers, R. L. Sackett; and American Institute of Electrical Engineers, Francis C. Pratt.

The Society for the Promotion of Engineering Education was represented by Dean W. E. Mott, School of Applied Science, Carnegie Institute of Technology. Dr. Glen Levin Swiggett represented the Committee of Fifteen on Educational Preparation for Foreign Service.

It was understood in advance that the sending of delegates by the four National Engineering Societies did not commit them to an endorsement of any action taken at the conference.

After a general discussion, through the better part of two sessions, it was found that the Committee was of the unanimous opinion that certain business courses should be added to all engineering courses in technical schools, in order to give the engineering graduate some knowledge of business, particularly emphasizing the questions of cost accounting, general economics, specifications and contracts, and business organization. The following propositions were submitted for consideration by the Bureau of Education:

*First.*—That a minimum number of hours in business training, to be determined by the Committee, be required in all engineering courses;

*Second.*—That a curriculum providing for a minimum of fifteen to thirty units in business economics be incorporated in all engineering courses and offered on an elective basis;

*Third.*—That a curriculum in commercial or industrial engineering, permitting full and proper emphasis on engineering subjects, be offered in the School of Commerce with degree to be given in that school;

*Fourth.*—That a five-year combined engineering and commercial course be prepared.

The Committee, after full discussion, decided that no action should be taken at this time on the third and fourth propositions, and, therefore, they approved the following recommendations, which will be considered by a general conference, to be held in the near future, of

representatives invited from the various engineering colleges and schools throughout the country:

*Recommendation One.*—That from 12 to 18 semester hours be required of all engineering students covering the following subjects:

1. General Economics.
2. Cost Accounting.
3. Business Organization.
4. Business Law.

*Recommendation Two.*—That for engineering schools desiring to extend further the commercial or industrial aspects of engineering, the following subjects are recommended as electives:

1. Labor and Employment.
2. Corporation Management and Finance.
3. Statistics.
4. Marketing.
5. Scientific Management.
6. Psychology.
7. Transportation.
8. Political Science.

*Recommendation Three.*—That the economic phases of engineering be emphasized in engineering instruction wherever possible.

### General Engineering Congress, Java, 1920

The *Proceedings* for August, 1918 (page 610) contained an item relating to the Engineering Congress to be held in Java, and additional information was printed in the *Proceedings* for December, 1918. In a communication from the Chairman of the Executive Committee of the Congress, dated January 21st, 1919, it is stated that the date for holding the Congress has been advanced to May, 1920, this being due to the receipt of information from various engineers and also from committees of societies, etc., that it would be impossible to go to Java or to send delegates in September, 1919 (the date previously set), owing to traveling and other conditions imposed by the war.

Engineers are invited to take part in the Congress by being present or by contributing papers and discussions on engineering subjects. Papers should be in the hands of the Executive Committee on or before June 1st, 1919. A few bulletins and circulars relative to the Congress have been received, and have been placed in the Reading-Room of the Society where those who are interested can obtain them.

### More Rapid Topographic Mapping Urged by Engineering Council

The advisability of the rapid completion of a topographic map of the United States was demonstrated during the World War. It is also now asserted that if the topographic survey of the country proceeds

at a rate no faster than that prescribed by Congress heretofore, a generation or more will pass before the work is completed.

With a view to assist in speeding up this important undertaking M. O. Leighton, M. Am. Soc. C. E., Chairman of the National Service Committee of Engineering Council, has sent the following letter to the Secretary of the Interior:

"WASHINGTON, D. C., MARCH 25TH, 1919.

"THE HONORABLE,
"THE SECRETARY OF THE INTERIOR,
"Washington, D. C.

"MY DEAR MR. SECRETARY:—It has become apparent to engineers, geologists, and others engaged, officially or otherwise, in development work that the Geological Survey should be granted a more liberal appropriation for topographic mapping. The demand for a complete topographic map of the United States is the result of dearly bought experience, and a realization that such a map is an essential part of that programme of development to which our country must resort if it is to respond to its own internal needs and to new world demands. Especially in the past two or three years has there been a wide acceptance of new ideas with respect to fundamental map necessities. The topographic map which was once considered a scientific convenience or an engineering luxury, is now recognized as an essential part of good engineering and a prime factor in the economic development of natural resources. Contributing largely to this new appreciation of good maps are the experiences of the Federal Government itself in the many activities that grew out of the war programme.

"It would require much space to review in any worthy way the needs for and the uses of a complete topographic map. We mention a few merely in order to assert that any one of them is of sufficient importance to warrant all the expenditures necessary to make a complete map. It is obvious that the maps are essential as a basis for National defense, and hardly second in importance is the need of them in connection with the enormous road building programme upon which the Government has entered. The two objects are largely interwoven. Did we have a complete topographic map of the country for use in the execution of our National road programme alone, the cash saving would exceed the cost of the map. The Federal policy of arid-land and swamp-land reclamation is also responsible for increased appreciation of map necessities, and not less important is the matter of power supply. The Boston-Washington power survey, which you advocated so ably before the Appropriations Committee of the 65th Congress, is merely one of many examples where a complete topographic map becomes a fundamental necessity. In the fields of mining and geology it has long been known that a map must be the forerunner of all productive work done on present-day scale. Finally, in the development and extension of railway systems, which forms one of the most important factors in our National progress, the topographic map has become the greatest single aid, time-saver, and means of economy that has been placed in the hands of the constructor. All of these uses and many others of similar purport are of first-class economic importance. The engineers of the country keenly appreciate these facts, and they

are earnestly asserting that a topographic map of the United States should be completed at as early a date as may be found consistent with accurate accomplishment.

"We might use much space in discussion of political and social necessities of topographic mapping, from either of which there could be derived adequate reasons for a most liberal topographic programme on the part of the Federal Government. Engineering Council, however, prefers to confine its consideration to the purely engineering features, leaving the discussion of other phases to other and more appropriate agencies.

"Information received from the Director of the Geological Survey gives assurance that there are trained topographers available to accomplish topographic work during the next fiscal year equivalent to the expenditure of $1 000 000. In the opinion of engineering officials, State geologists, and others who are well informed on the subject, the States of the Union are, in a majority of instances, ready and willing to co-operate more liberally than they have in the past. It is believed that the several States can be induced to make appropriations aggregating $500 000 for the next fiscal year. This, under the million-dollar programme, would leave the sum of $500 000 to be appropriated by Congress. It seems to us reasonable and wise to advocate such an appropriation for the next fiscal year. Present needs of the Government alone require a sum largely in excess of $500 000 for mapping necessary to the projects and investigations already authorized by Congress—projects which are in fact public work in progress. Detail facts concerning this are already familiar to you. It is respectfully urged that you consider the advisability of increasing the Geological Survey estimate for topography that you will present to the 66th Congress, from $350 000 to $500 000.

"The engineers of the country would emphasize the fact that the lack of a complete topographic map is retarding Government work and increasing the expense thereof to such an extent that the aggregate loss to the United States is many times greater than the amount necessary to make the map. There can be no question that similar losses are accruing to State and local governments for the same reason. Precise figures on this point cannot be cited without extended investigation, but we are none the less confident in asserting the conclusion. During past years the Geological Survey has covered a surprising amount of territory with the small appropriations made available to it, but it is evident that, at the present rate of progress, many years will elapse before the country is provided with a complete map. We believe that the projects and activities that must be sponsored by the present generation are of sufficient importance to demand that the present generation as well as future ones shall have the benefit of topography.

"Kindly be assured that if you find it possible to recommend to the 66th Congress an appropriation of $500 000 for the above recommended work in the next fiscal year, you will find practically unanimous support among American engineers and others who are well informed as to the necessities.

"Very respectfully,

"M. O. Leighton
*"Chairman National Service Committee."*

### Membership of American Society of Civil Engineers Passes 9 000

On March 24th, 1919, Mr. Lewis Malcolm Stoddard qualified as a Member of the American Society of Civil Engineers, and this brought the total membership of the Society up to 9 000.

### "Tentative Standard" Tests Adopted by the American Engineering Standards Committee

At a meeting of the American Engineering Standards Committee held on March 1st, 1919, Chairman Comfort A. Adams announced the result of a letter-ballot on the two standards presented by the American Society for Testing Materials, at the February 1st, 1919, meeting of the Committee, *viz.:*

1—A. S. T. M. Standard Specifications and Tests for Portland Cement.

2—A. S. T. M. Standard Specifications for Fire Tests of Materials and Construction.

As there were 13 affirmative votes cast, and none in the negative, these two standards become "Tentative Standards" of the American Engineering Standards Committee.

### Industrial Board of the Department of Commerce

The Council of National Defense is authorized to announce the creation, by the Hon. William C. Redfield, of "The Industrial Board of the Department of Commerce." Under the approval already given by the President to the Secretary of Commerce, this Board will be charged with the stabilization of prices for basic materials in such a way as to create a firm foundation on which the consumer can base his future purchases and the producer can form necessary production cost estimates. Its programme will be supported by the Council of National Defense.

This Board will consist of six carefully chosen men. The full personnel will be announced as soon as acceptances have been obtained. Already it is assured that the Chairman will be George N. Peek, of Moline, Ill., formerly Vice-Chairman of the War Industries Board. Hugh Frayne, the labor representative on the Board, was also on the War Industries Board as the representative of Labor, and the official representative of the Government in the new organization will be Thomas C. Powell, Director of Capital Expenditure of the Railroad Administration.

Through proper investigation and stabilization it is expected that the foundation can be laid for the resumption of American business and for furnishing employment to returning soldiers and sailors, through Government purchases, the publication of fair price lists, and the co-

operation of the producer. To obtain this co-operation, it is planned that the Board shall call the leaders of industry into consultation. The first of these conferences will be with representatives of industries producing basic materials, such as iron, steel, lumber, textiles, cement, copper, brick, etc.

The Board will endeavor to interchange views with these representatives of industry in the fullest and freest manner possible. If these conferences result in a general agreement among the important basic industries as to proper prices and bases for prices at which sales will be made, and this agreement is approved by the Board, it is believed that the announcement of this fact will induce the nation to feel justified in properly beginning a buying programme.

### Engineers' Registration Act for Oregon

The *Proceedings* for March, 1919 (pages 304-310), contained a copy of the Engineers' Registration Act for Oregon. The Act, as printed in *Proceedings,* has been amended as follows: On page 306, line 1, after the word "governor" insert "Said Board to consist of two civil engineers, two mechanical engineers, one electrical engineer, two hydraulic engineers, and two mining engineers;" on page 307, line 14 from the bottom, strike out the word "four" and insert the word "two" in lieu thereof. The Act, with these amendments, has received the approval of the Governor.*

### Cornell Library Contains Many Original Data

At Cornell University there is an unwritten law that an alumnus who engages in any new or original engineering work or investigation shall make a report on it to the Cornell Library. The result is that the Library of the University contains a great mass of information, as the alumni are said generally to live up to the unwritten law.

### Poles Preparing Commercial Relations with United States

Representatives of technical and commercial interests in the United States of Polish blood have organized the Society of Polish Engineers and Businessmen in America, to work in conjunction with the Commercial and Industrial Bureau of the Polish National Department, 33 West 42d Street, New York City, in developing closer relations between the new Republic of Poland and the United States.

* The statement with regard to the partial approval, by the Portland, Oregon, Association of Members of the American Society of Civil Engineers, of the Engineers Registration Act, which was published in the March, 1919, *Proceedings,* page 304, having been questioned by that Association, it should be stated that this news item was taken *verbatim* from a letter written by Roy A. Klein, Assoc. M. Am. Soc. C. E.—*Secretary.*

The organization is headed by Ralph Modjeski, M. Am. Soc. C. E., as Honorary President. Steven de Csesznak is President. The Society's headquarters are in the Engineering Societies' Building, 33 West 39th Street, New York City. Its functions are to associate Poles in America for the purpose of co-operating in the technical and commercial fields, and to do preparatory work toward bringing about closer economical relations between the United States and Poland.

Poland is the first of the new European States to establish in the United States an equipped commercial bureau for the development of trade relations between the two countries. The Polish National Department at Chicago, of which I. J. Paderewski, Premier of Poland, is Honorary President, and which comprises an executive council of the Polish societies in the United States, has opened a Commercial and Industrial Bureau in the Aeolian Building, 33 West 42d Street, New York City. This Bureau will endeavor to furnish American manufacturers and exporters with detailed data relative to the needs of Poland and later to arrange loans and credits to meet such purchases of raw and manufactured materials as Polish merchants and the Government of Poland may make here.

Mr. George Fudakowski, for many years an executive with the Westinghouse Electric and Manufacturing Company in Paris, Warsaw, and Petrograd, and recently associated with Mr. Paderewski in the relief work for Poland in the United States, has been named Director of the newly established Bureau. Through his organization, he is in official contact with Polish Government authorities in Paris, London, and Warsaw.

### Road Building in Pennsylvania

Recent press dispatches from Harrisburg, Pa., state that approximately 35 000 men will be employed during 1919 on road building in Pennsylvania. It is asserted that the State Highway Department plans to construct 600 miles of highway and that expenditures on road building during the next four years will approximate $100 000 000. A bill authorizing the State to issue bonds up to $50 000 000 is now going through the Legislature. Counties, it is expected, will spend many millions more for road building.

### Highway Construction in Texas

George A. Duren, State Highway Engineer of Texas, announces that the State is about to undertake a programme of highway construction of considerable magnitude. In order to achieve co-operation between the Highway Department's Engineers and the various County Engineers to govern the actual construction work, the Engineering Department of the University of Texas and the State Highway Depart-

ment conducted at the University a two weeks' course in Highway Construction and Maintenance. All County Engineers in the State were invited to attend this course which was held from March 31st to April 12th, 1919, inclusive, and which concluded with an examination on the subjects discussed.

### New Chairman of Interstate Commerce Commission

In accordance with the custom of the Interstate Commerce Commission of rotating its members in the presiding office in the order of seniority, Clyde B. Aitchison has been elected Chairman of the Commission. He was appointed a member of the body on September 29th, 1917, and his term expires in 1921.

### French Tunnel Commission is at Work

Albert Claveille, French Minister of Public Works, is presiding over meetings now being held by the commission appointed to study the subject of the Channel Tunnel. It is expected that definite plans for a Franco-British agreement will be developed.

### Americans on Siberian Railway Boards

The State Department has been notified of the personnel of the Technical and Military Boards which have undertaken to rehabilitate the Siberian Railway. The American members are Charles H. Smith on the Inter-Allied Committee, John F. Stevens, M. Am. Soc. C. E., President of the Technical Commission, and Col. Hugh J. Gallagher, U. S. A., on the Military Board.

### $500 000 for Research Work

The Rockefeller Foundation announced on March 30th, 1919, that it had appropriated $500 000 to support over a five-year period a research fellowship, in co-operation with the National Research Council, in the promotion of fundamental research in physics and chemistry. The funds and the details of the plan are to be administered by the Council. This action, according to President George E. Vincent of the Foundation, has resulted from a study of the best method of developing "pure research" aimed primarily at the discovery and understanding of basic principles, such as, for example, those governing light, stress being laid on the fundamental principles and not on the human inventions resulting therefrom.

## ANNOUNCEMENTS

**The Reading Room of the Society is open from 9 A. M. to 10 P. M., every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day; during July and August, it is closed at 6 P. M.**

### FUTURE MEETINGS

**May 7th, 1919.—8.30 P. M.**—A regular business meeting will be held, and a paper by A. F. Parker, M. Am. Soc. C. E., entitled "The East Canyon Creek Dam", will be presented for discussion.

This paper was printed in *Proceedings* for March, 1919.

**May 21st, 1919.—8.30 P. M.**—The arrangements for this meeting are in the hands of the New York Meetings Committee, and the programme for the evening will be announced later.

### ANNUAL CONVENTION

The Forty-ninth Annual Convention of the Society will be held in the "Twin Cities" of St. Paul and Minneapolis, Minn., from June 17th to 20th, 1919, inclusive.

The general arrangements for the Convention are in the hands of the following Committees:

*Committee of the Board of Direction*

W. L. Darling, *Chairman*

E. E. Wall — Chas. Warren Hunt

*Local Committee*

R. D. Thomas, *Chairman*

| | |
|---|---|
| W. C. Armstrong | W. H. Hoyt |
| F. H. Bass | W. N. Jones |
| R. B. C. Bement | F. C. Shenehon |
| F. W. Cappelen | H. E. Stevens |
| Oscar Claussen | P. E. Thian |
| William de la Barre | W. J. Walker |
| F. E. House | G. L. Wilson |

L. P. Wolff

A circular giving information as to the general programme, transportation, hotel rates, etc., will be issued later.

### ROLL OF HONOR

Now that the war is over, the monthly publication in *Proceedings* of the Roll of Honor has been discontinued. It is planned to publish later for permanent record a list of all the members of the American Society of Civil Engineers whose names have appeared on this list.

## ENGINEERING SOCIETIES EMPLOYMENT BUREAU

Engineering Societies Employment Bureau, established December 1st, 1918, as an activity of Engineering Council, is managed by a board made up of the Secretaries of the four Founder Societies, funds for its maintenance being provided by these Societies. The Bureau already is co-operating with engineering organizations in all parts of the country and with the Professional Section of the United States Employment Bureau. It is desirous of increasing such co-operation by working with local engineering associations and clubs. The work of the Bureau since its inception has been largely in the line of securing employment for men retiring from government war service. Members of the American Society of Civil Engineers who desire to register with this Bureau should apply for further information, registration forms, etc., to Walter V. Brown, Manager, Engineering Societies Employment Bureau, 16th Floor, Engineering Societies Building, 29 West 39th Street, New York City.

## SEARCHES IN THE LIBRARY

As the Library of the American Society of Civil Engineers has been merged in the Engineering Societies Library, requests for searches, copies, translations, etc., should be addressed to the Director, Engineering Societies Library, 29 West 39th Street, New York City, who will gladly give information concerning the charges for the various kinds of service. For a more comprehensive statement in regard to this matter, see *Proceedings* for March, 1919.

## PAPERS AND DISCUSSIONS

Members and others who take part in the oral discussions of the papers presented are urged to revise their remarks promptly. Written communications from those who cannot attend the meetings should be sent in at the earliest possible date after the issue of a paper in *Proceedings*.

All papers accepted by the Publication Committee are classified by the Committee with respect to their availability for discussion at meetings.

Papers which, from their general nature, appear to be of a character suitable for oral discussion will be published as heretofore in *Proceedings*, and set down for presentation to a future meeting of the Society, and, on these, oral discussions, as well as written communications, will be solicited.

All papers which do not come under this heading, that is to say, those which from their mathematical or technical nature, in the opinion of the Committee, are not adapted to oral discussion, will not be scheduled for presentation to any meeting. Such papers will be pub-

lished in *Proceedings* in the same manner as those which are to be presented at meetings, but written discussions only will be requested for subsequent publication in *Proceedings* and with the paper in the volumes of *Transactions*.

The Board of Direction has adopted rules for the preparation and presentation of papers, which will be found on page 35 of the Year Book for 1919.

## CONTRIBUTIONS TO PROCEEDINGS REQUESTED BY PUBLICATION COMMITTEE

The Committee on Publications will be glad to receive communications of general interest to the Society, and will consider them for publication in *Proceedings*. This is intended to cover letters or suggestions from our membership covering matters which are not of a technical character. Such communications, however, must not be controversial or commercial.

## LOCAL ASSOCIATIONS OF MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

**San Francisco Association, Organized 1905.**

E. J. Schneider, President; Nathan A. Bowers, Secretary-Treasurer, 502 Rialto Building, San Francisco, Cal.

The San Francisco Association of Members of the American Society of Civil Engineers holds regular bi-monthly meetings, with banquet, and weekly informal luncheons. The former are held at 6 P. M., at the Engineers' Club, 57 Post Street, on the third Tuesday of February, April, June, August, October, and December, the last being the Annual Meeting of the Association.

Informal luncheons are held at noon, every Wednesday, at the Engineers' Club, where special tables are reserved for members and guests of the Association.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in San Francisco, and any such member will be gladly welcomed as a guest.

**Colorado Association, Organized 1908.**

L. R. Hinman, President; A. N. Miller, Secretary-Treasurer, 1400 West Colfax Avenue, Denver, Colo.

The meetings of the Colorado Association of Members of the American Society of Civil Engineers (Denver, Colo.) are held on the second Saturday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary. The meetings are usually preceded by an informal dinner. Members of the American Society of Civil Engineers will be welcomed at these meetings.

Weekly luncheons are held on Wednesday at 12.30 P. M., at Daniels and Fisher's.

Visiting members are urged to attend the meetings and luncheons.

**Atlanta Association, Organized 1912.**

T. P. Branch, President; J. T. Wardlaw, Secretary-Treasurer, 1530 Healey Bldg., Atlanta, Ga.

Informal luncheons are held for members of the Association on the last Monday of each month, at 12.30 P. M. The place is not fixed, but this information will be furnished on application to the Secretary.

**Baltimore Association, Organized 1914.**

H. G. Perring, President; Charles J. Tilden, Secretary-Treasurer, The Johns Hopkins University, Baltimore, Md.

**Cleveland Association, Organized 1914.**

F. D. Richards, President; George H. Tinker, Secretary-Treasurer, 516 Columbia Building, Cleveland, Ohio.

**Detroit Association, Organized 1916.**

T. A. Leisen, President; Clarence W. Hubbell, Secretary, 2348 Penobscot Building, Detroit, Mich.

The regular meetings of the Association are held on the second Friday of December, April, and October, the last being the Annual Meeting.

**District of Columbia Association, Organized 1916.**

A. P. Davis, President; John C. Hoyt, Secretary-Treasurer, U. S. Geological Survey, Washington, D. C.

**Duluth Association, Organized 1917.**

W. B. Patton, President; Walter G. Zimmermann, Secretary, Wolvin Building, Duluth, Minn.

The regular meetings of the Association are held at noon on the third Monday of each month (usually at the Kitchi Gammi Club), with luncheon, followed by a short business session and the reading of papers. Visiting members of the American Society of Civil Engineers can secure from the Secretary definite information relative to the meetings, at which they will be welcomed. The Annual Meeting is held on the third Monday in May.

(Abstract of Minutes of Meeting)

**March 24th, 1919.**—The meeting was called to order at the Kitchi Gammi Club; President W. B. Patton in the chair; Walter G. Zimmermann, Secretary; and present also, 23 members and 3 guests.

The project for the formation of an engineering library received encouragement through the receipt of an offer from the City Librarian to provide space in the City Library for the use of the Duluth Engineers Club and the Duluth Association.

Messrs. Hutchinson, Christie, and Ash were appointed a Library Committee, and to this Committee was referred the investigation of the Clarence Coleman Library, with a view to its purchase as a nucleus of the new library.

Mr. Hoyt reported briefly on the Annual Convention of the Society to be held at the Twin Cities probably from June 17th to 20th, 1919. The plan for the Duluth visit is: to leave Minneapolis by special train on the afternoon of June 19th, arriving at Duluth that evening, and leaving for the Mesaba Range on the morning of June 20th, touring the Range by automobiles and returning to Duluth that evening *via* Two Harbors. The Duluth programme is being prepared by the Entertainment Committee composed of Messrs. Stack, Lewis, and Pickles.

The President introduced Col. Francis A. Pope, who gave a most interesting talk on his experiences in the service of the American Expeditionary Forces in France.

The President announced that Mr. E. R. Lewis, a Director of the Association, had associated himself with the *Railway Age* at Chicago, where he is to serve on the editorial staff on special work, and expected to leave Duluth in a few days. The President expressed sincere regrets at Mr. Lewis' leaving, calling attention to the fact that, from the start, he had been one of the loyal members, that he had never spared time or effort in promoting the welfare of the Association, and that the membership was greatly indebted to him for the interest he had always taken in the organization.

Mr. Lewis responded, expressing his regrets at being obliged to sever his connection with the Association, but hoping to visit his Duluth friends occasionally in the future.

Adjourned.

**Illinois Association, Organized 1916.**

H. J. Burt, President; Edgar S. Nethercut, Secretary-Treasurer, 1735 Monadnock Blk., Chicago, Ill.

The regular meetings of the Association are held on the second Monday of March, June, September, and December, the last being the Annual Meeting. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

**Louisiana Association, Organized 1914.**

Arsène Perrilliat, President; Eugene F. Delery, Secretary, 2007 Laharpe Street, New Orleans, La.

The regular meetings of the Association are held at The Cabildo, New Orleans, La., on the first Monday of January, April, July, and October.

**Nebraska Association, Organized 1917.**

Adna Dobson, President; Homer V. Knouse, Secretary-Treasurer, 109 City Hall, Omaha, Nebr.

Regular meetings of the Association are held on the first Saturday of each month, except July and August, and at such places as may be appointed from time to time by the Executive Committee. The Annual Meeting is held in Lincoln, Nebr., on the second Friday in January.

Visiting members of the Society are especially urged to communicate with the Secretary when in the city.

**Northwestern Association, Organized 1914.**

Ralph D. Thomas, President; W. N. Jones, Secretary, City Engineer's Office, City Hall, Minneapolis, Minn.

The meetings of the Association are held bi-monthly, alternating between St. Paul and Minneapolis, on the third Friday of each month. Information as to the time and place of such meetings will be furnished on application to the Secretary.

**Philadelphia Association, Organized 1913.**

F. Herbert Snow, President; Henry T. Shelley, Secretary, 416 City Hall, Philadelphia, Pa.

The regular meetings of the Association are held at the Engineers' Club of Philadelphia, 1317 Spruce Street, on the first Monday in January, April, and October, the last being the Annual Meeting.

**Pittsburgh Association, Organized 1917.**

Robert A. Cummings, President; Nathan Schein, Secretary-Treasurer, 1510 Carson Street, Pittsburgh, Pa.

The Annual Meeting of the Association is held on the first Monday in October. The time and place of other meetings are not fixed, but this information will be furnished on application to the Secretary.

(Abstract of Minutes of Meeting)

**February 28th, 1919.**—The meeting was called to order at the Fort Pitt Hotel; President R. A. Cummings in the chair; Nathan Schein, Secretary; and present, also, 45 members.

George W. Fuller, M. Am. Soc. C. E., a member of the American Delegation to the Engineering Congress in Paris, addressed the Association on his experiences and observations in France.

The Chairmen of the four Sub-Committees on Development presented their reports, and these were discussed fully by those present.

Adjourned.

**Portland, Ore., Association, Organized 1913.**

E. Burslem Thomson, President; C. P. Keyser, Secretary, 318 City Hall, Portland, Ore.

**St. Louis Association, Organized 1888 (Constitution Approved by Board, 1914).**

J. A. Ockerson, President; C. W. S. Sammelman, Secretary-Treasurer, 300 City Hall, St. Louis, Mo.

The Annual Meeting of the Association, for the election of officers and for the transaction of business, is held on the fourth Monday in November. Two meetings each year, for the presentation and discussion of technical papers, are held in the Auditorium of the Engineers Club of St. Louis and are open to members of the Associated Societies. Other "get-together" meetings are held regularly for dinner or luncheon on the fourth Monday of each month except July, August, and November.

**San Diego Association, Organized 1915.**

W. C. Earle, President; Ralph Wueste, Secretary-Treasurer, Bonita, Cal.

**Seattle Association, Organized 1913.**

L. M. Grant, President; Phil A. Franklin, Secretary, 1409 East 65th St., Seattle, Wash.

The regular meetings of the Association, with luncheon, are held at the Engineers' Club, Arctic Building, Third Avenue and Cherry Street, at 12.15 P. M., on the last Monday of each month.

Special evening meetings are held from time to time for the purpose of discussing important topics, and information concerning these meetings may be had by addressing the Secretary. All members in any grade of the American Society of Civil Engineers are cordially invited to attend the meetings when in the vicinity, and, if located in this District for any length of time, their membership in the Association will be appreciated.

**Southern California Association, Organized 1914.**

George G. Anderson, President; Floyd G. Dessery, Secretary, 514 Central Building, Los Angeles, Cal.

The Southern California Association of Members of the American Society of Civil Engineers (Los Angeles, Cal.) holds regular monthly meetings on the second Wednesday of each month, the December meeting being the Annual Meeting.

Informal luncheons in connection with the Joint Technical Societies of Los Angeles are held at 12.15 P. M. every Thursday at the Broadway Department Store Café.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in Los Angeles, and any such member will be gladly welcomed as a guest at any of the meetings or luncheons.

(Abstract of Minutes of Meeting)

**March 12th, 1919. (Special Meeting).**—The meeting was called to order at Christopher's Café: President G. G. Anderson in the chair; F. G. Dessery, Secretary; and present, also, 39 members and 25 guests.

The minutes of the meeting of February 12th, 1919, were read and approved.

Mr. John W. Alvord, Member of the Board of Direction of the Society, and Mr. Calvin W. Rice, Secretary of the American Society of Mechanical Engineers, were present and addressed the meeting briefly.

The resolutions adopted by the St. Louis Association on January 28th, 1919, relative to the financial support of Engineering Council, were read, and also correspondence between Secretary Dessery and Alfred D. Flinn, Secretary of Engineering Council. Following statements by Directors Alvord and Hawgood, it was decided that no action in the matter was required, either by Local Associations or individual members.

The resolutions adopted by the Philadelphia Association on February 24th, by the Cleveland Association on February 25th, by the Texas

Association on February 24th, and a letter from Mr. W. H. Hoyt, of Duluth, Minn., relative to the Committee on Development, were read, and, after brief discussion, it was decided to withhold the appointment of a committee within the Association for the present. President Anderson, the Association's representative on the Committee on Development, announced that such a committee would be appointed when occasion required it.

The Secretary announced the addition of 13 members to the roll, and 1 resignation.

The topic for the meeting was "Flood Control in Southern California," a symposium to extend over a number of meetings.

President Anderson introduced the subject, giving a clear and succinct review of the problems involved and to be considered. This was prefaced by a few remarks on the purpose of the Programme Committee in arranging for such symposia, which was, in effect, to stimulate the membership by more frequent intercourse, by the technical presentation of local engineering problems, and by consideration of the interest of the community.

Mr. F. H. Olmsted presented a comprehensive historical sketch, especially directed to the conditions in Los Angeles County. Mr. A. L. Sonderegger discussed at length the physiography of the region as pertaining to flood control problems.

The discussion is to be continued at the ensuing monthly meetings.

Adjourned.

**Spokane Association, Organized 1914.**

Peter Mogensen, President; Charles E. Davis, Secretary, City Engineer's Office, Spokane, Wash.

The regular meetings of the Association are held on the second Friday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

Visiting members are invited to attend the meetings.

**Texas Association, Organized 1913.**

R. J. Potts, President; J. H. Brillhart, Secretary, Care, Mosher Mfg. Co., Dallas, Tex.

**Utah Association, Organized 1916.**

A. B. Villadsen, President, 304 Dooly Block, Salt Lake City, Utah.

The Annual Meeting of the Association is held on the first Wednesday in April. The time of other meetings is not fixed, but this information will be furnished on application to the President.

## PRIVILEGES OF ENGINEERING SOCIETIES EXTENDED TO MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Members of the American Society of Civil Engineers will be welcome in the Reading Rooms and at the meetings of many engineering societies in all parts of the world. A list of such societies will be found on pages 41 and 42 of the Year Book of the Society for 1919.

# ACCESSIONS TO THE ENGINEERING SOCIETIES LIBRARY

(From March 1st to 31st, 1919)

## DONATIONS*

**The statements made in these notices are taken from the books themselves, and this Society is not responsible for them.**

### THE SHIPBUILDING INDUSTRY.

By Roy Willmarth Kelly and Frederick J. Allen; With an Introduction by Charles M. Schwab. Bost. and N. Y., Houghton, Mifflin Company, 1918. 303 pp., 64 pl., 8 x 6 in., cloth. $3.00.

The primary purpose of this volume, as stated by the authors, is to describe and interpret for the general public, as well as for those employed in the shipyards, our war emergency shipping programme and the task of the shipbuilders. It is also hoped that the book will help those who wish to prepare themselves for executive positions and those considering shipbuilding or naval architecture as a possible life calling.

### STEAM ENGINE TROUBLES:

A Practical Treatise for the Engineer, Telling How to Locate and Remedy Troubles with a Steam Engine; Cylinders, Valves, Pistons, Frames, Pillow Blocks and Other Bearings, Connecting Rods, Wristplates, Dashpots, Reachrods, Valve Gears, Governors, Piping, Throttle and Emergency Valves, Safety Stops, Flywheels, Oilers, etc., are All Treated. By H. Hamkens. N. Y., The Norman W. Henley Publishing Co., 1919. 284 pp., 276 illus., 8 x 5 in., cloth. $2.50.

A simple account of the troubles which may arise in steam engine operation, the causes, and the proper remedies, intended for the power plant engineer. Based on a series of articles published in *Power*.

### AERONAUTICAL ENGINES:

A Critical Survey of Current Practice with Special Reference to the Balancing of Inertia Forces. By Francis John Kean. 2d ed. New York, Spon & Chamberlain; Lond., E. & F. N. Spon, Ltd., 1918. 101 pp., 49 illus., 31 pl., 8 x 5 in., cloth. $2.50.

This book consists of a course of ten lectures given during 1915 to men of the Royal Naval Air Service and the Royal Flying Corps, designers, and engineering students. Contents: The Nature of the Problems; Classifications of Aeroplane Engines; Relative Advantages of Different Types of Aeroplane Engines; Choosing the Number of Cylinders; Balancing the Sliding Parts of the Engine; Carburetion; Ignition; Typical Aeroplane Engines; Appendix.

### GASOLINE AND KEROSENE CARBURETORS:

Construction—Installation—Adjustment; A Simple, Comprehensive Treatise for Practical Men, Explaining all Principles Pertaining to Carburetors for all Types of Internal Combustion Engines Intended to Operate on Liquid Fuels, Such as Gasoline, Kerosene, Benzol, and Alcohol. By Victor W. Pagé. New York, The Norman W. Henley Publishing Co., 1919. 219 pp., 89 illus., 8 x 5 in., cloth. $1.50.

This book is a handbook for operators of internal combustion engines, in which are explained, in non-technical language, the principles of carburetors, the usual modern types, and the method of adjusting and repairing them.

*Unless otherwise specified, books in this list have been donated by the publishers.

COMPRESSED AIR PLANT.

By Robert Peele. 3d ed. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 485 pp., 246 illus., 54 tab., 9 x 6 in., cloth. $4.25.

This edition has undergone a thorough revision. A number of chapters have been rewritten and several have been expanded, while old material has been condensed or omitted. The volume describes current practice in the construction and operation of compressors and discusses the applications of compressed air drilling, pumping, and hauling, with special reference to mine service.

MODEL MAKING:

Including Workshop Practice, Design and Construction of Models; A Practical Treatise for the Amateur and Professional Mechanic, Giving Instructions on the Various Processes and Operations Involved in Model Making and the Actual Construction of Numerous Models, Including Steam Engines, Speed Boats, Guns, Locomotives, Cranes, etc.; Lathe Work, Pattern Work, Electroplating, Soft and Hard Soldering, Grinding, Drilling, etc., are also Included. Edited by Raymond Francis Yates. N. Y., The Norman W. Henley Publishing Co., 1919. 390 pp., 303 illus., 1 pl., 9 x 6 in., cloth. $3.00.

The author hopes that his book will promote interest in model engineering in this country and will also give a correct impression of its value as a recreation.

PUBLIC UTILITY RATE FIXING:

Comments on Current Problems Pertaining to Public Utilities and to Rate Fixing. By C. E. Grunsky. San Fran., Technical Publishing Company, 1918. 169 pp., 5 charts, 2 pl., 9 x 6 in., cloth. $2.50.

A reprint of a number of articles originally contributed to the *Journal of Electricity*, written in the hope that they may prove helpful in determining fair rates for the output of public utilities and in prescribing methods of procedure when rates are to be fixed; and that they may assist in the solution of some of the economic problems which arise in the readjustment to peace conditions.

RADIATION, LIGHT AND ILLUMINATION.

By Charles Proteus Steinmetz. Compiled and Edited by Joseph LeRoy Hayden. 3d ed. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1918. 305 pp., 127 illus., 1 pl., 14 tab., 9 x 6 in., cloth. $3.00.

A series of twelve experimental lectures, most of which were delivered in 1908–09, with the exception of two lectures on "Light Flux and Distribution," and "Light Intensity and Illumination." The treatment is non-mathematical and discusses the subjects in plain language. This edition is apparently a reprint of the preceding ones.

NOMON: A CALCULATING CHART. A MANUAL OF CHEMICAL NOMOGRAPHY.

By Horace G. Deming. Champaign, Ill., The University Press, 1918. In Two Parts, Text and Tables. $1.25. (Gift of Miles & Parris.)

The Nomon is a nomographic reckoner, devised by the author, for the graphic solution of various arithmetical problems. Multiplication, division, powers, roots, and logarithms can be treated by the eighteen charts, with an average error of one part in four thousand or five thousand. The Manual describes the method of using the Nomon, gives specific examples of its application to the solution of chemical problems, and indicates the kinds of calculations in which it is most useful.

**HANDBOOK OF CHEMISTRY AND PHYSICS.**

Compiled by Charles D. Hodgman, Assisted by Melville F. Coolbaugh and Cornelius E. Senseman. Cleveland, Ohio, The Chemical Rubber Co., 1918. 557 pp., 7 x 4 in., flexible cloth. $2.50.

This compilation is intended to present in one volume of convenient size a comparatively comprehensive reference book for the use of chemists and physicists. The seventh edition has been enlarged by 100 pages, which contain a revision of a table of the physical constants of organic compounds. This table now includes about two thousand substances. Various minor additions and corrections have been made throughout the work.

**COTTON FACTS:**

Compilation from Official and Reliable Sources of the Crops, Receipts, Exports, Stocks, Home and Foreign Consumption, Visible Supply, Prices, and Acreage of Cotton in the United States and Other Countries for a Series of Years, also Cotton Mill Statistics of the United States, Europe, India, etc., the Reports of Condition of Growing Cotton Crops, Issued by the U. S. Department of Agriculture, and the Cotton Acreage and Yield of Each State and County in the South According to the U. S. Census. Edited by Carl Geller. October, 1918, Edition. N. Y., Shepperson Publishing Co., 1918. 240 pp., 1 pl., 7 x 4 in., cloth. $1.00.

This volume is the forty-third annual issue. In a book of pocket size, it presents the statistics needed by cotton merchants, manufacturers, and growers, as indicated in the title.

**NINETEENTH YEAR BOOK**

Of The Rubber Association of America, Inc. N. Y., 1918. 119 pp., 9 x 6 in., paper.

The Year Book contains a list of the members, the constitution, and the annual report of the Association for 1918.

**HEATON'S ANNUAL, 1919.**

Published by Heaton's Agency. Toronto, Canada, 512 pp. (including advertisements), 7 x 5 in., cloth. $1.50.

A handbook of condensed commercial and industrial information on Canada. Describes the natural and commercial resources of the provinces, and industrial opportunities in the towns and cities. Much general information of use to visitors and business men is included.

**STRUCTURAL ENGINEERS' HANDBOOK:**

Data for the Design and Construction of Steel Bridges and Buildings. By Milo S. Ketchum. 2d ed. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1918. 896 pp., 165 tab., 9 x 6 in., flexible cloth. $5.00.

In preparing the new edition of this working manual for engineers, draftsmen, and students, the author has added details of steel windows and doors, data on cement and gypsum tile roofs, solutions for bending moments in mill building columns and stresses in stiff frames, has rewritten and enlarged the chapter on steel highway bridges, and has corrected all known errors.

**THE DESIGN AND CONSTRUCTION OF DAMS:**

Including Masonry, Earth, Rock-fill, Timber, and Steel Structures, Also the Principal Types of Movable Dams. By Edward Wegmann. 6th ed., rev. and enl.; 1918 reprint rev. N. Y., John Wiley & Sons, Inc., 1918. 529 pp., 198 illus., 157 pl., 24 tab., 12 x 9 in., cloth. $6.00.

The present volume is a reprint, with revisions, of the sixth (1911) edition of this well-known and popular treatise. A special feature of the book is the detailed information given concerning important dams in all parts of the world.

## MEMBERSHIP

(From March 7th to April 3d, 1919)

### ADDITIONS

| MEMBERS | | Date of Membership |
|---|---|---|
| Albert, Frederick Wilhelm. Lt.-Col., U. S. A., 33d Engrs., Am. Exp. Forces, France; Address, 23 Isham St., Burlington, Vt. | Assoc. M. | Mar. 4, 1914 |
| | M. | Jan. 14, 1919 |
| Babbitt, Henry Keepers. Supt., E. I. du Pont de Nemours & Co., Inc., Pompton Lakes, N. J. | | Mar. 11, 1919 |
| Bixby, Frederick Louis. Senior Irrig. Engr., Bureau of Public Roads, U. S. Dept. of Agriculture, Univ. of Nevada, Reno, Nev. | Assoc. M. | June 6, 1911 |
| | M. | Mar. 11, 1919 |
| Bowman, Bion Angelo. Div. Engr., Fay, Spofford & Thorndike, 308 Boylston St., Boston, Mass. | | Mar. 11, 1919 |
| Boyajohn, Haig Milton. Superv. of Sub-Contracts, Am. International Shipbuilding Corporation, Hog Island, Pa. | Assoc. M. | June 4, 1913 |
| | M. | Mar. 11, 1919 |
| Comstock, Harold Dearborn. Project Mgr., Riverton Project, U. S. Reclamation Service, Riverton, Wyo. | Assoc. M. | April 5, 1910 |
| | M. | Mar. 11, 1919 |
| Cone, William Smith. Cons. Engr. (Cone & Harris), 1216 Hollingsworth Bldg., Los Angeles, Cal. | | Nov. 26, 1918 |
| Dobson, Gilbert Colfax. Maj., Engrs., U. S. A.; Prof. of Military Science and Tactics, Colorado School of Mines, Golden, Colo. | Assoc. M. | May 2, 1911 |
| | M. | Mar. 11, 1919 |
| Epple, Edward Charles. Chf. Engr., Am. Concrete Steel Co., Newark (Res., 36 Cleveland Terrace, Bloomfield), N. J. | | Mar. 11, 1919 |
| Ericson, Frederick Anson. Structural Engr., Thomas E. Murray, 64 Daily St., Nutley, N. J. | | Mar. 11, 1919 |
| Farrin, James Moore. Capt., Engrs., U. S. A., 2d Engrs., Am. Exp. Forces, France. | Assoc. M. | Nov. 30, 1909 |
| | M. | Sept. 10, 1918 |
| Fawley, James Linwood. Vice-Pres. and Chf. Engr., Geo. F. Pawling & Co., 1432 South Penn Sq., Philadelphia, Pa. | | Mar. 11, 1919 |
| Fougner, Nicolay Knudtzon. Pres., Fougners Staal-Beton Skibsbygn. Co., A/S (Fougner Concrete Shipbuilding Co.), Sjofartsbygningen, Christiania, Norway. | Assoc. M. | Feb. 4, 1913 |
| | M. | Nov. 26, 1918 |
| Greene, Russell de Costa. Asst. Chf. Engr., Am. Cyanamid Co., 511 Fifth Ave., New York City. | Assoc. M. | June 4, 1913 |
| | M. | Mar. 11, 1919 |
| Hansen, Hans Jorgen. Office Engr., C., M. & St. P. Ry., 1055 North Francisco Ave., Chicago, Ill. | | Mar. 11, 1919 |

MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| JOHNSON, ARTHUR ALBERT. 1st Lieut., Engrs., U. S. A., 22d Engrs., Am. Exp. Forces, France; Address, 901 M St., N. W., Washington, D. C. | | Jan. 13, 1919 |
| PRICE, WILLIAM EDMUND. Contr. (Campbell & Price), 611 Majestic Bldg., Oklahoma, Okla. | Jun. | April 5, 1910 |
| | Assoc. M. | Jan. 2, 1912 |
| | M. | Mar. 11, 1919 |
| RYAN, WALTER JACKMAN. Snoqualmie Falls, Wash. | Jun. | May 5, 1908 |
| | Assoc. M. | Mar. 1, 1910 |
| | M. | Mar. 11, 1919 |
| SEARS, WILLIAM HATFIELD. Archt. and Heating Engr., James Bldg., Chattanooga, Tenn. | Assoc. M. | April 18, 1916 |
| | M. | Mar. 11, 1919 |
| SHANKLAND, RALPH GRAHAM. 1st Lieut., Engrs., U. S. A., U. S. General Hospital No. 16, New Haven, Conn.; With E. C. & R. M. Shankland, 1106 The Rookery, Chicago, Ill. | Jun. | Nov. 8, 1909 |
| | Assoc. M. | Sept. 3, 1913 |
| | M. | Mar. 11, 1919 |
| STODDARD, LEWIS MALCOLM. Seattle, Wash. | | Mar. 11, 1919 |
| SULLIVAN, MAURICE JOSEPH. City Archt., 207 City Hall, Houston, Tex. | Assoc. M. | Mar. 4, 1914 |
| | M. | Mar. 11, 1919 |
| TARR, CHARLES WINTHROP. Vice-Pres. and Gen. Mgr., Morris Knowles, Ltd., Windsor, Ont., Canada (Res., The Elms, 110 Henry St., Detroit, Mich.) | Assoc. M. | June 6, 1906 |
| | M. | Mar. 11, 1919 |
| WEST, ROBERT KIRBY. Capt., Engrs., U. S. A., 3d Aviation Instruction Center, A. P. O. 724, Am. Exp. Forces, France. | | Oct. 8, 1918 |
| WHITTIER, WILMOT EDGAR. Care, U. S. Reclamation Service, Clint, Tex. | | Mar. 11, 1919 |

ASSOCIATE MEMBERS

| | | |
|---|---|---|
| ANDERSON, ROBERT SUMTER. 201 Fontenelle Apartments, 5th and Denver Sts., Tulsa, Okla. | Jun. | Mar. 14, 1916 |
| | Assoc. M. | Mar. 11, 1919 |
| AUSTIN, HERBERT SIDNEY. Chf. Engr., Oklahoma Pipe Line Co., P. O. Drawer 1458, Muskogee, Okla. | | Mar. 11, 1919 |
| BABB, CHARLES STEWART. With Barber Asphalt Paving Co., 1328 Tribune Bldg., Chicago, Ill. | | Mar. 11, 1919 |
| BEANFIELD, RUFUS MCCLELLAN. Engr., Div. of Shipyard Plants, Emergency Fleet Corporation, 140 North Broad St., Philadelphia, Pa. | | Mar. 11, 1919 |
| BORDEN, GEORGE WILLIAM. Goldendale, Wash. | | Nov. 26, 1918 |
| BURKE, EDMUND POTTS. 706 Kresge Bldg., Detroit, Mich. | | Mar. 11, 1919 |
| BUTTERFIELD, DYER. With Price-Evans Foundry Co., Chattanooga, Tenn. | | Mar. 11, 1919 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership |
|---|---|---|
| Byars, George Emmett. City Engr., City Hall, Waco, Tex | | Oct. 8, 1918 |
| Carman, Charles Bloomfield. Capt., Engrs., U. S. A., Raritan Arsenal, Metuchen, N. J | | Mar. 11, 1919 |
| Chandler, Jermain. Designing and Cons. Engr., 561 Spitzer Bldg., Toledo, Ohio | | Mar. 11, 1919 |
| Chapin, Franklin Henry. Asst. Bridge Engr., Alaskan Eng. Comm., Anchorage, Alaska | | Jan. 13, 1919 |
| Colhoun, Daniel Warwick. Maj., Tank Corps, U. S. A., Camp Meade, Md | | Sept. 10, 1918 |
| Corbin, Horace Kellogg. 1st Lieut., Q. M. C., U. S. A., Constr. Div., 30 Church St., New York City | Jun.<br>Assoc. M. | June 24, 1914<br>Mar. 11, 1919 |
| Corwin, Daniel Chauncey. Asst. Supt., Raymond Concrete Pile Co., 113 Thirty-fourth St., Norfolk, Va | | Mar. 11, 1919 |
| Cramer, William Nathaniel. Asst. Engr., Valuation Dept., Ill. Cent. R. R., Room 706, Central Station, Ill. Cent. R. R., Chicago, Ill | | Mar. 11, 1919 |
| Drake, Ralph Edmund. 254 South 4th St., Fulton, N. Y | Jun.<br>Assoc. M. | Jan. 31, 1911<br>Mar. 11, 1919 |
| Duckwall, Anderson Edward. Designer, H. C. Frick Coke Co., 500 George St., Scottdale, Pa | | Mar. 11, 1919 |
| Dugan, Frank Clarke. Capt., Engrs., U. S. A., Office, Chf. of Engrs., 6th and B Sts., Room 5-303, Bldg. C, Washington, D. C | | Mar. 11, 1919 |
| Fishach, Leyborn Grier. Care, Emergency Fleet Corporation, 136 South 16th St., Philadelphia, Pa | | Mar. 11, 1919 |
| Haasis, Cuthbert Wead. 5713 Euclid Ave., Cleveland, Ohio | | Mar. 11, 1919 |
| Haswell, John Robert. Senior Drainage Engr., Bureau of Public Roads, 1350 Irving St., N. W., Washington, D. C. (Res., 402 Delaware Ave., Wilmington, Del.) | Jun.<br>Assoc. M. | June 4, 1913<br>Jan. 14, 1918 |
| Henderson, Joseph Newcom. Civ. and Min. Engr. (Herbert & Henderson), Box 131, Kittanning, Pa | | Mar. 11, 1919 |
| Henderson, Volney Howard. McAllen, Tex | | Nov. 26, 1918 |
| Hesselberger, Milton. Municipal Engr. and Licensed Surv., 307 Tajo Bldg., Los Angeles, Cal | | Mar. 11, 1919 |
| Hight, William Clarence. (Pritchett & Hight), Walnut Ridge, Ark | | Mar. 11, 1919 |
| Hoyt, Sidney Merrill. Capt., Q. M. C., U. S. A., Constr. Div., Bldg. C, Room 3-331, 7th and B Sts., Washington, D. C | | Sept. 10, 1918 |

ASSOCIATE MEMBERS (*Continued*)

| | Date of Membership |
|---|---|
| JAMESON, ROBERT OLEN. Chf. Engr., W. C. Hedrick Const. Co., 342 South Rosemont Ave., Dallas, Tex | Mar. 11, 1919 |
| MANHEIMER, LOUIS B. Capt., Engrs., U. S. A.; Asst. Dept. Engr., Southeastern Dept., U. S. War Dept., Charleston, S. C | Nov. 26, 1918 |
| MILLER, KARL ANDREW. Sergeant, Care, G-2-C, Headquarters, 3d Army, Am. Exp. Forces, Coblenz, Germany — Jun. | Dec. 2, 1914 |
| — Assoc. M. | Jan. 13, 1919 |
| MURPHY, KENDALL TUTTLE. Box 237, Penniman, Va | Oct. 9, 1917 |
| OTIS, WILBUR CORTHELL. Outside Supt., Public Works Dept., Navy Yard, Boston, Mass | Mar. 11, 1919 |
| RICHARDSON, FRANK EDISON. Mgr., Gasoline Dept., Okmulgee Producing & Refining Co., Inc., Box 806, Henryetta, Okla | Mar. 11, 1919 |
| SCHNEPFE, FREDERICK ERNEST. 3141 Frederick Ave., Baltimore, Md | Nov. 26, 1918 |
| SMITH, ROSCOE LEE. 122 East Front St., Berwick, Pa | Mar. 11, 1919 |
| STANLEY, LLOYD LAWRENCE. 1st Lieut., Engrs., U. S. A., 3325 Eighteenth St., N. W., Washington, D. C. (Res., 526 West 10th St., Sioux Falls, S. Dak.) | Mar. 11, 1919 |
| VAN SISE, ANDREW JACKSON. County Engr., Audubon County, Audubon, Iowa — Jun. | Jan. 15, 1917 |
| — Assoc. M. | Jan. 13, 1919 |
| WARMAN, WILLIAM RYMOND. Broadway, N. J | Oct. 8, 1918 |
| WELLS, WALTER MELVIN. 416 Insurance Exchange, San Francisco, Cal | Sept. 10, 1918 |
| WHITMORE, HAROLD CUSHING. Constr. Engr., Stone & Webster, 145 Broadway, Pawtucket, R. I. — Jun. | April 30, 1912 |
| — Assoc. M. | Mar. 11, 1919 |
| WILLCOMB, ROLAND HOWARD. Engr., City of San Diego; Res. Engr., Lower Otay Dam, Lowerotay, Cal | Jan. 13, 1919 |
| WILMOT, SYDNEY. Asst. Prof. of Eng., Brown Univ. (Res., 63 Elmgrove Ave.), Providence, R. I. — Jun. | Nov. 8, 1909 |
| — Assoc. M. | Jan. 13, 1919 |
| WRIGHT, THOMAS PARKS. Cons. Engr. (Geo. N. Mitcham & Thos. P. Wright), 712 Flatiron Bldg., Atlanta, Ga. | Mar. 11, 1919 |

ASSOCIATES

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| SCHMIDT, FRED RUDOLPH. Sales Mgr., The United States Portland Cement Co., 305 Ideal Bldg., Denver, Colo. | Mar. 11, 1919 |

JUNIORS

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| HANSELMAN, WILLIAM LOUIS. 152 Midland Ave., Montclair, N. J | Mar. 11, 1919 |
| RICHARDSON, THOMAS COLYER. P. O. Box 559, Vicksburg, Miss. | Sept. 10, 1918 |
| VAN EENENAAM, CORNELIUS. Care, County Highway Dept., St. Clair County, Belleville, Ill | Mar. 11, 1919 |

### DEATHS

BROWN, RALPH HENRY. Elected Member, June 7th, 1899; died February 22d, 1919.

GEER, HARVEY MOSHER. Elected Member, June 6th, 1894; died March 18th, 1919.

HALCOMBE, NORMAN MARSHALL. Elected Junior, September 3d, 1907; Associate Member, May 2d, 1911; died February 15th, 1919.

HAZLEHURST, JAMES NISBET. Elected Member, October 4th, 1899; died February 9th, 1919.

STEVENS, GEORGE M. Elected Associate Member, November 6th, 1907; died September, 1918.

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**Total Membership of the Society, April 3d, 1919, 9 011.**

## MONTHLY LIST OF RECENT ENGINEERING ARTICLES OF INTEREST

(March 1st, to March 22d, 1919)

NOTE.—*This list is published for the purpose of placing before the members of this Society, the titles of current engineering articles, which can be referred to in any available engineering library, or can be procured by addressing the publication directly, the address and price being given wherever possible.*

### LIST OF PUBLICATIONS

*In the subjoined list of articles, references are given by the number prefixed to each journal in this list:*

(2) *Journal,* Engrs. Club of Phila., Philadelphia, Pa.
(3) *Journal,* Franklin Inst., Philadelphia, Pa., 50c.
(4) *Journal,* Western Soc. of Engrs., Chicago, Ill., 50c.
(5) *Journal,* Eng. Inst. of Canada, Montreal, Que., Canada.
(6) *Journal,* Am. Inst. of Archts., Washington, D. C., 50c.
(8) *Stevens Indicator,* Hoboken, N. J., 50c.
(9) *Industrial Management,* New York City, 25c.
(11) *Engineering* (London), W. H. Wiley, 432 Fourth Ave., New York City, 25c.
(12) *The Engineer* (London), International News Co., New York City, 35c.
(13) *Engineering News-Record,* New York City, 15c.
(15) *Railway Age,* New York City, 15c.
(16) *Engineering and Mining Journal,* New York City, 15c.
(17) *Electric Railway Journal,* New York City, 10c.
(18) *Railway Review,* Chicago, Ill., 15c.
(19) *Scientific American Supplement,* New York City, 10c.
(20) *Iron Age,* New York City, 20c.
(21) *Railway Engineer,* London, England, 1s. 2d.
(22) *Iron and Coal Trades Review,* London, England, 6d.
(24) *American Gas Engineering Journal,* New York City, 10c.
(25) *Railway Mechanical Engineer,* New York City, 20c.
(26) *Electrical Review,* London, England, 4d.
(27) *Electrical World,* New York City, 10c.
(28) *Journal,* New England Water-Works Assoc., Boston, Mass., $1.
(29) *Journal,* Royal Society of Arts, London, England, 6d.
(32) *Mémoires et Compte Rendu des Travaux,* Soc. Ing. Civ. de France, Paris, France.
(33) *Le Génie Civil,* Paris, France, 1 fr.
(36) *Cornell Civil Engineer,* Ithaca, N. Y.
(42) *Proceedings,* Am. Inst. Elec. Engrs., New York City, $1.
(43) *Annales des Ponts et Chaussées,* Paris, France.
(45) *Coal Age,* New York City, 10c.
(46) *Scientific American,* New York City, 15c.
(47) *Mechanical Engineer,* Manchester, England, 3d.
(54) *Transactions,* Am. Soc. C. E., New York City, $12.
(55) *Mechanical Engineering:* Journal, Am. Soc. M. E., New York City, $10.
(56) *Transactions,* Am. Inst. Min. and Metallurgical Engrs., New York City, $6.
(57) *Colliery Guardian,* London, England, 5d.
(58) *Proceedings,* Engrs.' Soc., W. Pa., 2511 Oliver Bldg., Pittsburgh, Pa., 50c.
(59) *Proceedings,* American Water-Works Assoc., Troy, N. Y.
(60) *Municipal and County Engineering,* Indianapolis, Ind., 25c.
(61) *Proceedings,* Western Railway Club, 225 Dearborn St., Chicago, Ill., 25c.
(62) *American Drop Forger,* Thaw Bldg., Pittsburgh, Pa., 10c.
(63) *Minutes of Proceedings,* Inst. C. E., London, England.
(64) *Power,* New York City, 5c.
(65) *Official Proceedings,* New York Railroad Club, Brooklyn, N. Y., 15c.
(66) *Gas Journal,* London, England, 6d.
(67) *Cement and Engineering News,* Chicago, Ill., 25c.
(71) *Journal,* Iron and Steel Inst., London, England.
(71a) *Carnegie Scholarship Memoirs,* Iron and Steel Inst., London, England.
(72) *American Machinist,* New York City, 15c.
(73) *Electrician,* London, England, 18c.
(74) *Transactions,* Inst. of Min. and Metal., London, England.
(75) *Proceedings,* Inst. of Mech. Engrs., London, England.
(77) *Journal,* Inst. Elec. Engrs., London, England, 5s.
(83) *Gas Age,* New York City, 15c.
(85) *Proceedings,* Am. Ry. Eng. Assoc., Chicago, Ill.
(86) *Engineering and Contracting,* Chicago, Ill., 10c.
(87) *Railway Maintenance Engineer,* Chicago, Ill., 10c.

(89) *Proceedings*, Am. Soc. for Testing Materials, Philadelphia, Pa., $5.
(90) *Transactions*, Inst. of Naval Archts., London, England.
(91) *Transactions*, Soc. Naval Archts. and Marine Engrs., New York City.
(92) *Bulletin*, Soc. d'Encouragement pour l'Industrie Nationale, Paris, France.
(93) *Revue de Métallurgie*, Paris, France, 4 fr. 50.
(96) *Canadian Engineer*, Toronto, Ont., Canada, 10c.
(98) *Journal*, Engrs. Soc., Pa., Harrisburg, Pa., 30c.
(99) *Proceedings*, Am. Soc. of Municipal Improvements, New York City, $2.
(100) *Professional Memoirs*, Corps of Engrs., U. S. A., Washington, D. C., 50c.
(101) *Metal Worker*, New York City, 10c.
(103) *Mining and Scientific Press*, San Francisco, Cal., 10c.
(104) *The Surveyor and Municipal and County Engineer*, London, England, 6d.
(105) *Chemical and Metallurgical Engineering*, New York City, 25c.
(106) *Transactions*, Inst. of Min. Engrs., London, England, 6s.
(107) *Schweizerische Bauzeitung*, Zürich, Switzerland.
(109) *Journal*, Boston Soc. C. E., Boston, Mass., 50c.
(110) *Journal*, Am. Concrete Inst., Philadelphia, Pa., 50c.
(111) *Journal of Electricity*, San Francisco, Cal., 25c.
(113) *Proceedings*, Am. Wood Preservers' Assoc., Baltimore, Md.
(114) *Journal*, Institution of Municipal and County Engineers, London, England, 1s. 6d.
(115) *Journal*, Engrs.' Club of St. Louis, St. Louis, Mo., 35c.
(116) *Blast Furnace and Steel Plant*, Pittsburgh, Pa., 15c.
(117) *Engineering World*, Chicago, Ill.
(118) *Times Engineering Supplement*, London, England, 2d.
(119) *Landscape Architecture*, Harrisburg, Pa., 50c.
(120) *Automotive Industries*, New York City, 15c.

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### Bridges.

Concrete Caissons Sunk by the Open Dredging Method.* L. W. Skov. (4) June, 1918.
New and Little-Known Methods of Calculation of Girders, Beams and Arches.* James S. Martin. (58) Dec., 1918.
Arch Analysis by a Method Using Variable Elastic Weights.* F. J. Dulude. (13) Mar. 6.
Reinforced Concrete Slab Bridge Design Based on Tests of Full-Size Slabs.* A. T. Goldbeck. (From *Public Roads.*) (96) Mar. 6.
Canadian Reinforced Concrete Arch Bridges.* Frank Barber. (96) Mar. 13.
Move Bridge Spans 136 Ft. Endwise on Car Trucks.* (13) Mar. 13.
Cantilever Erection of Draw in Open Position While Old Draw Serves as Fixed Span.* (13) Mar. 20.
Keep Accurate Costs on War-Time Fee Contract.* Farley Gannett and J. D. Carpenter. (13) Mar. 20.

### Electrical.

The Supply of Single-Phase Power from Three-Phase Systems.* Miles Walker. (77) Jan.
The Conversion of Complex Quantities.* W. H. Grinsted. (73) Feb. 14.
An Electrolytic Method of Determining the Electric Field Round an Insulator. W. Estorff. (Abstract of article in *Electrotechnische Zeitschrift.*) (73) Feb. 14.
The Resistance of an Electrolytic Cell.* Edgar Newbery. (Abstract of paper read before Faraday Soc.) (73) Feb. 14.
Electric Generation by Diesel Engine.* E. J. Richards. (111) Feb. 15.
Electric Cables at Mines.* W. T. Anderson. (Abstract of paper read before Assoc. of Min. Elec. Engrs.) (22) Feb. 21.
Notes on Losses in Sheet Iron at High Frequencies.* Marius Latour. (Paper read before Société Internationale des Electriciens.) (73) Feb. 21.
The Influence of the Distribution of Losses on the Efficiency Curves of a Continuous Current Motor.* Thomas Carter. (73) Serial beginning Feb. 21.
Starting Synchronous Motors. E. E. George. (27) Mar. 1.
Radio Apparatus for Artillery Fire Control.* G. Francis Gray and John W. Reed. (27) Mar. 1.
Filing System for Central Station Use.* C. C. Hogan. (111) Mar. 1.
Modern Welding by Electricity. (From *Electrical Review.*) (19) Mar. 1.
Effect of Interpoles on Commutation of Direct-Current Machines.* R. L. Witham. (64) Mar. 4.
The Standardization of Polyphase Voltages. R. Rüdenberg. (Abstract of article in *Elektrotechnische Zeitschrift.*) (73) Mar. 7.
Live Roller Motors in Steel Works.* W. W. Wood. (Abstract of article in *Magnet Magazine.*) (73) Mar. 7.
Radio Direction-Finding Apparatus.* A. S. Blatterman. (27) Mar. 8.

* Illustrated.

**Electrical—(Continued).**

Tests of Ignition Apparatus.* P. M. Heldt. (120) Mar. 13.
Extending the Life of Wood Poles.* Charles R. Harte. (17) Mar. 22.
Design of Small Direct-Current Armatures.* C. R. Wylie. (27) Mar. 29.
Recherches sur le Fonctionnement Chimique de l'Accumulateur au Plomb. Ch. Fery. (92) Jan.
La Mécanisme de la Rupture des Isolants Electriques.* (33) Feb. 1.

**Marine.**

The Application of Electric Welding to Steel Shipbuilding.* H. A. Horner. (58) Jan.
La Marche des Mines Flottantes dans l'Atlantique Nord et l'Ocean Glacial pendant et après la Guerre.* Albert de Monaco. (33) Jan. 18.
Double-Reduction Geared Turbines for *S. S. Mereda.** (11) Feb. 14.
Economic Size of Concrete Ships.* E. O. Williams. (11) Feb. 14.
The British Two-Stroke Motor.* (For Ships.) (12) Feb. 21.
The Shipping Situation and the Construction of the Squantum Destroyer Plant.* Thomas C. Atwood. (28) Mar.
Speed Dimensions and Form of Cargo Vessels.* G. S. Baker and J. L. Kent. (Paper read before Inst. of Engrs. and Shipbuilders in Scotland.) (11) Mar. 7.
British Concrete Shipyards.* W. Noble Twelvetrees. (11) Mar. 14.
F-5-L Navy Flying Boat.* S. T. Williams. (120) Serial beginning Mar. 20.
Side Launching a Concrete Lighter.* (13) Mar. 20.
Fabricated Ship Construction at Bristol Yard.* (13) Mar. 20.
Le Problème de la Marine Marchande, son Importance pour la France Pendant et Après la Guerre. Emile Gouault. (33) Jan. 11.
Kuhlschiffe für Lebensmitteltransport.* H. Guyer. (107) Feb. 8.
Turbo-elektrischer Schiffschrauben-Antrieb von Ljungström. (107) Feb. 15.

**Mechanical.**

Advantages of High Pressure and Super-Heat as Affecting Steam Plant Efficiency.* Eskil Berg. (4) June, 1918.
The Use of High-Pressure and High-Temperature Steam in Large Power Stations.* J. H. Shaw. (77) Jan.
Torsional Loads in the Fuselage of an Aeroplane.* A. J. Sutton Pippard. (11) Feb. 14.
The Manufacture and Design of Toothed Gearing.* Joseph Chilton. (Paper read before the North-East Coast Inst. of Engrs. and Shipbuilders.) (11) Serial beginning Feb. 14.
Fusing Temperature of Ash. Arno C. Fieldner and Others. Abstract of Report issued by U. S. Bureau of Mines.) (22) Feb. 14.
Conveyors in Relation to Engineering Works.* W. W. Atherton. (117) Feb. 15.
Secondary Reactions of Oxide of Iron Purification. G. Weyman. (66) Feb. 18.
The Draper Coal Washing Machine.* G. Knox. (Abstract of paper read before South Wales Inst. of Engrs.) (12) Feb. 21.
The Optical Determination of Stresses in Aeroplane Spars.* A. R. Low. (Paper read before Royal Aeronautical Soc.) (11) Feb. 21.
Handling of Coke.* C. J. Woodhead. (Paper read before Manchester and Junior Gas Assoc.) (66) Feb. 25.
Low-Temperature Carbonization in Relation to the Production of Motor Spirit, Fuel Oils, Smokeless Fuel, and Power Gas: Its Aims and Objectives.* F. B. Marshall. (66) Serial beginning Feb. 25; (22) Feb. 28.
Sliding Friction in Ball-Bearings.* Arvid Palmgren. (11) Feb. 28.
The Measurement of Fluid Velocity and Pressure.* J. R. Pannell. (11) Serial beginning Feb. 28.
The Visibility of Airplanes.* M. Luckiesh. (3) Mar.
Stresses in Wire Rope.* Shortridge Hardesty. (55) Mar.
Liberty Engine Tests.* (55) Mar.
The Loomis Cooling System for Aircraft.* (From *Bulletin* of the Experimental Dept., Bureau of Aircraft Production.) (55) Mar.
The Value of Insulation and Losses in B. T. U.'s.* William N. Allman. (25) Mar.
Lubrication of Air Compressors.* H. U. Conrad. (Extract from Report issued by Compressed Air Soc.) (16) Mar. 1; (86) Mar. 19; (20) Mar. 20.
Operating a Water Gas Set without a Relief Holder in Parallel with By-Product Coke Ovens.* A. H. Harris, Jr. (24) Mar. 1.
Calculation of Plant Efficiencies and Fuel Costs.* J. T. Foster. (64) Mar. 4.
Water-Tube Boiler Tube Ruptures.* Weldon Melroy. (64) Mar. 4.
Use of Lignite, Bagasse and Wood Waste for Power Generation and Heating.* John B. C. Kershaw. (45) Mar. 6.
The Altitude Engine Test Laboratory.* P. M. Heldt. (For Aeroplanes.) (120) Mar. 6.
Pulverized Coal Burners *versus* Stokers.* Joseph T. Foster. (27) Mar. 8.
The Utilization of Peat for Power Generation.* John B. C. Kershaw. (12) Serial beginning Mar. 14.

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* Illustrated.

**Mechanical—(Continued).**

The 270-H. P. Basse-Selve Aero Engine.* (12) Mar. 14.
All-New Water Gas Plant Results at Providence.* Wm. Russell. (Abstract of paper read before New England Gas Men.) (83) Serial beginning Mar. 15.
Deoxidizing Water to Prevent Pipe Corrosion. F. N. Speller. (Abstract of paper read before Am. Soc. of Heating and Ventilating Engrs.) (16) Mar. 15.
Areas of Segments of Boiler Heads.* (64) Mar. 18.
Chart for Finding the Factor of Evaporation.* G. H. Sheasley. (64) Mar. 18.
Factors in High-Speed Engine Development.* D. McCall White. (Paper read before Soc. of Automotive Engrs.) (120) Serial beginning Mar. 20.
Radiator Cooling Fans.* George W. Hoyt. (From a paper read before Soc. of Automotive Engrs.) (120) Mar. 20.
F-5-L Navy Flying Boat.* S. T. Williams. (120) Serial beginning Mar. 20.
Bureau of Standards Carbureter Test Plant.* P. M. Heldt. (120) Mar. 20.
On Proportioning Engine Bearings.* Otto M. Burkhardt. (From a paper read before Soc. of Automotive Engrs.) (120) Mar. 20.
Treatment of Acidulous Water for Steam Purposes. E. A. Reilly. (45) Mar. 20.
La Fabrication des Pierres à Briquets en Ferro-Cérium, Système Visseaux. A. Frillat. (92) Jan.
Notes sur le Soudage des Verres. Léon Appert. (92) Jan.
Appareil Indicateur-Totalisateur de la Consommation de Charbon, Système Lea.* P. Letheule. (33) Feb. 8.
La Fabrication de la Verrerie de Laboratoire en Angleterre. (33) Mar. 1.
L'Utilisation Commerciale des Aéronefs Rigides. A. Poidlouë. (33) Mar. 1.
Vom Quecksilberdampf-Gleichrichter.* (107) Sept. 28, 1918.
Entwicklungsformen des Dampf-Kälteprozesses.* P. Ostertag. (107) Jan. 25.
Ueber Toleranzen im Maschinenbau. Ad. Debrunner. (107) Feb. 8.

**Metallurgical.**

The Application of Electric Welding to Steel Shipbuilding.* H. A. Horner. (58) Jan.
The Evolution of the Puddling Process. Cecil H. Desch. (Abstract of paper read before Staffordshire Iron and Steel Inst.) (22) Serial beginning Feb. 14.
Experimenting with the Electric Furnace. Wirt S. Scott. (111) Feb. 15.
The Electron-Furnace Spectrum of Iron. G. A. Hemsalech. (11) Feb. 21.
Uses Electric Furnace in Malleable Foundry.* F. L. Prentiss. (20) Feb. 27.
Electric Welding.* J. H. Paterson. (Paper read before Assoc. of Eng. and Shipbuilding Draughtsmen.) (11) Feb. 28.
Electric Furnaces as Applied to Steel Making.* Henry Lawrence Hess. (55) Mar.
Heat Treatment of Low-Carbon Steel.* W. M. Wilkie. (55) Mar.
Checking Pyrometers to Get Results.* (62) Mar.
Milling Calculations.* Robert S. Lewis. (105) Mar. 1.
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Concentration of Graphite Ores.* George D. Dub. (Abstract from War Minerals Investigation Series No. 3, U. S. Bureau of Mines.) (103) Mar. 1.
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Foundry Built Around a Shop Truck.* (20) Mar. 6.
Foundry Ventilation.* (From *Foundry World.*) (20) Mar. 6.
A Technical Study of Acid Bessemer Steel. Richard S. McCaffery. (Abstract of article from *Wisconsin Engineer.*) (20) Mar. 6.
Live Roller Motors in Steel Works.* W. W. Wood. (Abstract of article in *Magnet Magazine.*) (73) Mar. 7.
International Nickel Company's Refining Works at Port Colborne, Ontario.* W. L. Wotherspoon. (16) Mar. 8.
Calibration of Base-Metal Thermocouples.* C. S. Crouse. (16) Mar. 8.
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The Hardening of Steel.* H. C. H. Carpenter. (Paper read before Royal Inst.) (11) Mar. 14.
Melting Brass in a Rocking Electric Furnace.* H. W. Gillett and A. E. Rhoades. (From *Bulletin* issued by U. S. Bureau of Mine.) (11) Mar. 14.
Magnetic Concentration of Pyrrhotite Ores.* J. P. Bonardi. (U. S. Bureau of Mines.) (105) Mar. 15.
Observations on Flaky and Woody Steel.* Federico Giolitti. (105) Mar. 15.
Decomposition of Metals.* A. I. Krynitzky. (105) Mar. 15.
Temperature Uniformity in an Electric Furnace.* John B. Ferguson. (From *Physical Review.*) (105) Mar. 15.
The Practical Analysis of Molding Sand.* F. Albert Hayes. (For Foundry Work.) (20) Mar. 20.
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Standards of Temperature and Means of Checking Pyrometers.* (72) Mar. 20.
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Re-treating Zinc Tailings in Wisconsin.* W. F. Boericke. (16) Mar. 22.

* Illustrated.

**Military.**

Notes on the Field Emplacement of a German Large Caliber Gun.* G. B. Pillsbury. (100) Nov., 1918.
Operation of the Utilities at Camp Devens, Mass.* Edward W. Briggs. (109) Feb.
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The Boston Army Supply Base—Construction Features. Charles R. Gow. (109) Mar.
The Boston Army Supply Base—General Data. Charles M. Spofford. (109) Mar.
Radio Apparatus for Artillery Fire Control.* G. Francis Gray and John W. Reed. (27) Mar. 1.
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Electric Heat Treatment of Gun Forgings.* C. E. Wright. (20) Mar. 13.
Standard Gauge Railway Work at the Front. (96) Mar. 20.
La Marche des Mines Flottantes dans l'Atlantique Nord et l'Ocean Glacial pendant et après la Guerre.* Albert de Monaco. (33) Jan. 18.

**Mining.**

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Separation-Doors at the Bottom of the Upcast Pit, Worked Automatically by Tubs Attached to Endless-Rope (Undertub-Tub) Haulage.* Clement Fletcher. (106) Jan.
Electric Generation by Diesel Engine.* E. J. Richards. (Copper Mining.) (111) Feb. 15.
Removal of a Vertical Shaft Pillar.* (117) Feb. 15.
Use of the Cement Gun in a Bituminous Coal Mine.* M. S. Sloman. (117) Feb. 15.
Humidity of Deep Mines. Sydney F. Walker. (117) Feb. 15.
Electric Cables at Mines.* W. T. Anderson. (Abstract of paper read before Assoc. of Min. Elec. Engrs.) (22) Feb. 21.
Ferro-Concrete Coal Pit Props. (117) Mar. 1.
Sampling of Dust in Mine Air.* J. Boyd. (Abstract.) (16) Mar. 1.
Breaking of Cable in Protection Shaft.* Robert Dunn. (45) Mar. 13.
Modern Shaft Development of the Consolidation Coal Company.* George W. Harris. (45) Serial beginning Mar. 13.
Neutralizing Acid Mine Water. (Abstract from *South African Mining Journal and Engineering Record.*) (16) Mar. 15.
Rand Gold Mining.* "South African". (16) Mar. 15.
Methods and Cost of Driving a 10 x 12 Ft. Mining Tunnel at Copper Mountain, B. C. (86) Mar. 19.
The Mines of Bruay, France.* Gaston Libiez. (45) Mar. 20.
Ventilation Methods in Coeur d'Alene Mines. Robert N. Bell. (Abstract from Report of State Inspector of Mines of Idaho.) (103) Mar. 22.

**Miscellaneous.**

The Variation of Measuring Instruments.* Frederick J. Schlink. (Paper issued by U. S. Bureau of Standards.) (11) Feb. 14.
Uniform Filing System. C. C. Hogan. (111) Feb. 15.
Fundamentals of a Uniform Cost Accounting System. G. A. Schonlau. (117) Feb. 15.
The Composition of Petroleum and Coal. J. Marcusson. (From *Chemiker Zeitung.*) (57) Feb. 21.
Filing System for Central Station Use. C. C. Hogan. (111) Mar. 1.
The Altitude Engine Test Laboratory.* P. M. Heldt. (120) Mar. 6.
Melting Points and Other Temperatures.* (From *Circular* of the Bureau of Standards.) (16) Mar. 15.
Les Efforts de l'Industrie française pendant la Guerre: Dévelopment Actuel de l'Industrie de l'Acétate de Cellulose et de ses Applications. Clément et Rivière. (92) Sept., 1918.
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# PAPERS AND DISCUSSIONS

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# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

# PAPERS AND DISCUSSIONS

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# PAPERS AND DISCUSSIONS

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## PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By Norman R. Gibson, M. Am. Soc. C. E.

Synopsis.

This paper shows how the rise of pressure caused by the gradual closing of turbine gates may be determined from Professor Joukovsky's theory of maximum water-hammer. A solution of the problem by the trial-and-error method of arithmetic integration is first given, and then formulas are derived that cover any governor time and any relation between governor stroke and gate movement. Two factors which affect the rise of pressure are taken into consideration: (1) the elasticity of water and of the walls of the penstock; and (2) the effect of the net head on the phenomena which occur during the closing of the gates. Previous writers have submitted formulas which neglect one or other of these two factors, with the result that they do not give correct results in all cases. The limitations of such formulas are determined by the solution of the problem herein submitted.

* This paper will not be presented for discussion at any meeting of the Society, but written communications on the subject are invited for subsequent publication in *Proceedings*, and with the paper in *Transactions*.

## Introduction.

The purpose of this paper is to show how the excess pressure in penstocks caused by the gradual closing of turbine gates may be determined from Professor Joukovsky's theory of water-hammer. It will be assumed that the theory of pressure waves, their amplitudes, and speeds of propagation, as formulated by him and proved by his experiments, may be accepted as correct.

At the risk of wearying the reader who is familiar with Joukovsky's work, it is necessary, in connection with what is to follow, to summarize as briefly as possible the principles demonstrated a number of years ago by this distinguished Russian. For a partial translation of his work, the reader is referred to Miss O. Simin's paper entitled "Water Hammer"* which should be examined carefully by every student of this subject.

Joukovsky's experiments, made in 1908 at Moscow, were confined to the instantaneous stopping of the flow of water in long pipes. By his experiments he was able to prove the soundness of his analytical determination of the maximum rise of pressure that would occur when the flow of water in a pipe was suddenly arrested. The casual thinker at first would imagine that—as force is equal to the product of mass by acceleration—an infinite pressure would be produced in a pipe if the water flowing in it were stopped instantaneously. On second thought, he would realize that neither the water column nor the walls of the pipe are rigid, and therefore the pressure caused by the shock of stopping the flow suddenly is relieved by the slight compression of the water and the expansion of the walls of the pipe. It was the effect of these two factors that was determined by Professor Joukovsky. He showed that the shock pressure is transmitted along the column of water in the pipe in waves similar to sound waves; and that the shock pressure is proportional to the destroyed velocity of flow and to the speed of propagation of the pressure waves. This speed depends on the compressibility of water, on the elasticity of the materials of the pipe, and on the ratio of the thickness of the walls of the pipe to its diameter. In other words, if the speed of the pressure wave is known, the maximum pressure produced (called water-hammer) by instantane-

* *Proceedings,* Am. Water Works Assoc., 1904, p. 341.

ously stopping water flowing in a pipe at any velocity may be calculated.

Joukovsky's formula for water-hammer is:

$$h = \frac{a\,V}{g} \qquad (1)$$

where $h$ = excess pressure, in feet;

$V$ = velocity of flow in the pipe, in feet per second;

$g$ = gravitational unit, in feet per second per second;

and $a$ = velocity of the pressure wave, in feet per second, which is determined by the formula:

$$a = \frac{12}{\sqrt{\frac{W}{g}\left\{\frac{1}{k} + \frac{d}{E\,e}\right\}}} \qquad (2)$$

where $W$ = weight of a cubic foot of water, in pounds;

$g$ = gavitational unit, in feet per second per second;

$k$ = voluminal modulus of water, in pounds per square inch;

$d$ = diameter of pipe, in inches;

$e$ = thickness of pipe walls, in inches;

$E$ = modulus of elasticity of material of pipe walls, in pounds per square inch.

Joukovsky showed also that the shock pressure is transmitted along the pipe with constant intensity and "at constant velocity, which seems to be independent of the intensity of the shock."

"The speed of propagation of the pressure wave remains the same, whether the shock is caused by arresting the flow of a column of water moving in a pipe, or by suddenly changing the pressure in the column of water (flowing or standing) in any part and by any other means."

"If the water column continues flowing, such flow exerts no noticeable influence upon the shock pressure. In a pipe from which water is flowing, the pressure wave is reflected from the open end of the pipe, in the same way as from a reservoir with constant pressure."

"The phenomenon of periodical vibration of the shock pressure is completely explained by the reflection of the pressure wave from the ends of the pipe, *i. e.*, from the gate and from the orgin [of the pipe]."*

Pressure waves, after traveling up the penstock to the origin or point of relief and back to the gate, are reflected and transmitted again over the same course, as waves of rarefaction or sub-normal pressure.

* Quotations are from "Water Hammer" by Miss O. Simin.

In this manner pressure waves, alternately super-normal and sub-normal, travel up and down the penstock until damped out by friction. During the time taken by the wave to traverse its course from gate to origin the pressure at the gate remains at its full value, either super-normal or sub-normal, as the case may be.

Briefly stated, then, the premises are: that when water flowing in a pipe is suddenly arrested, certain pressure waves, the characteristics of which are known, are produced and propagated along the pipe at constant speed and constant magnitude, and that the speed and magnitude of these waves may be calculated for any given conditions.

## Fundamental Equations.

It is the writer's intention to apply herein this theory of pressure waves to the phenomena which occur when the gates of a turbine at the end of a penstock are gradually closed. The damping effect of friction on the pressure waves will be neglected during the time of closure. The variable velocity of the pressure wave due to the difference in density of the water at the top and bottom of the penstock will also be neglected. For the sake of simplicity, it will be assumed that the gate opening is closed uniformly from full open to shut by a governor which moves the gates at uniform velocity from the beginning of its stroke to the end, and that the area of gate opening is directly proportional to the amount of gate movement. It may be stated here, parenthetically, that the resulting formulas may be modified, easily, to suit any method of gate closure, whether the speed of closing and the relation of governor movement to area of gate opening is uniform or variable.

When the gates of a turbine are closed gradually the velocity of the water in the penstock is reduced to zero and the pressure in the penstock rises. It is frequently assumed that the reduction in velocity takes place uniformly, but the rise of pressure, which commences immediately after the gates begin to move, increases the velocity of discharge through the gate opening, and, during the early part of the gate movement, tends to diminish the rate at which the flow of the water is retarded. This variable rate of retardation, during the time the gates are being closed, has an important bearing on the resulting rise of pressure, and it is necessary to take it into consideration by

determining the relation between the velocity of flow and the pressure in the penstock. This relation may be expressed by the equation:

$$V_0 = B_0 \sqrt{H_0} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where $V_0$ = initial velocity, in feet per second, of the water in the penstock before shut down;

$H_0$ = normal net head, in feet;

and $B_0$ = a number representing the gate opening. The value of $B_0$ is best determined from the known value of $V_0$ and $H_0$, but, in fact, $B_0$ is the ratio of the area of the gate opening to the area of the penstock multiplied by $\sqrt{2g}$ times the coefficient of discharge of the gate opening.

At any time during the closing of the gates the relation between $V$, $B$, and $H$ would be expressed by the general formula, $V = B\sqrt{H}$. If the gates are closed in the time, $T$, and $t$ is the time from the beginning of the stroke to any time before the end of the stroke, the value of $B_t$ (that is, $B$ at the end of the time, $t$) for uniform closing, would be $\left(1 - \frac{t}{T}\right) B_0$. During the time, $t$, the pressure in the penstock has risen an amount, $h_t$, so that the net head, $H_t$ (that is, $H$ at the end of the time, $t$) would be equal to $H_0 + h_t$. Therefore, the expression for the value of $V_t$ (that is $V$ at the end of the time, $t$) is:

$$V_t = \left(1 - \frac{t}{T}\right) B_0 \sqrt{H_0 + h_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

### Calculation by Arithmetic Integration.

Before proceeding with the analytical determination of $h_t$, it will perhaps make the work clearer to show first, by a numerical example, how $h_t$ may be otained by the trial-and-error method of arithmetic integration. Assume that the gate, instead of being moved in a continuous uniform manner, is closed by a series of small instantaneous movements with a slight pause between each movement. Each little movement of the gate would destroy instantaneously a small part, $\Delta V$, of the velocity, $V_0$, and, since this part of the velocity is destroyed instantaneously, the rise of pressure, according to Joukovsky, would be $h = \frac{a\,\Delta\,V}{g}$. When the first instantaneous movement has taken place, let

a pause of time, $t$, elapse before the next movement. Then $\Delta V = V_0 - V_t$, and $h_t = \frac{a(V_0 - V_t)}{g}$.

By these equations and Equation (4) a numerical example may now be solved, and at the same time there will be explained other interesting phenomena caused by the closing of the gates and the pressure waves produced thereby. The analytical work may then be more readily understood.

Let $L = 820$ ft.;

$V_0 = 11.75$ ft. per sec.;

$H_0 = 165$ ft.;

$T = 2.1$ sec. (For convenience, $T$ has been chosen an even multiple of $\frac{2L}{a}$);

$a = 4\,680$ ft. per sec. (This value of $a$ is chosen simply because this example was worked out by the writer for a pipe in a tunnel and concreted in. The expansion of the pipe walls, therefore, was neglected. For any condition, $a$ may be obtained by Equation (2)).

Since $V_0 = B_0 \sqrt{H_0}$, then $B_0 = 0.91476$.

Assume that the gates are closed in 24 successive instantaneous movements. The time elapsing between each movement would then be 0.0875 sec. After the first of these movements had taken place the gates would have been closed one-twenty-fourth of their opening, and the number representing the gate opening would have been reduced by one-twenty-fourth of its value, that is, $\frac{0.91476}{24} = 0.038115$. At each of the successive movements the value of $B$ is reduced by the same amount, as the gate motion is assumed to be uniform. It will not be necessary, however, to use more than the first three significant figures, and the work may be done on the slide-rule. In this example the recovery of the friction head in the penstock will be neglected.

From the foregoing may now be written the first three columns of Table 1, and the first line of Columns 4 and 5. The table may then be completed as follows: Assume a trial reduction in velocity, caused by the initial instantaneous movement of the gate, and set the figure down in Column 5 under the value of $V_0$ and subtract it from $V_0$, placing

TABLE 1.—By Arithmetic Integration.

Data: $L = 820$ ft. $V_0 = 11.75$ ft. per sec. $H_0 = 165$ ft. $T = 2.1$ sec. $a = 4\,680$ ft. per sec. Friction neglected.

| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|
| Interval. | Time, $t$. | Gate, $B$. | Head, $H$. | Velocity, $V$. | 145 $\Delta V$, $\Delta h$. | $\Sigma(\Delta h)$, $h_t$. |
| 0 | 0.0000 | 0.91476 | 165.00 | 11.75 | | |
| | | 0.03811 | | 0.085 | 12.32 | |
| ¼ | 0.0875 | 0.87665 | 177.32 | 11.665 | | 12.32 |
| | | 0.03811 | | 0.095 | 13.78 | |
| ½ | 0.1750 | 0.83854 | 191.10 | 11.570 | | 26.10 |
| | | 0.03811 | | 0.10 | 14.50 | |
| ¾ | 0.2625 | 0.80043 | 205.60 | 11.47 | | 40.60 |
| | | 0.03811 | | 0.112 | 16.20 | |
| 1 | 0.3500 | 0.76232 | 221.80 | 11.358 | | 56.80 |
| | | 0.03811 | | 0.258 | 37.40 | |
| 1¼ | 0.4375 | 0.72421 | 234.56 | 11.10 | | 69.56 |
| | | 0.03811 | | 0.29 | 42.10 | |
| 1½ | 0.5250 | 0.68610 | 249.10 | 10.81 | | 84.10 |
| | | 0.03811 | | 0.30 | 43.50 | |
| 1¾ | 0.6125 | 0.64799 | 263.60 | 10.51 | | 98.60 |
| | | 0.03811 | | 0.33 | 47.80 | |
| 2 | 0.7000 | 0.60988 | 279.00 | 10.18 | | 114.00 |
| | | 0.03811 | | 0.43 | 62.30 | |
| 2¼ | 0.7875 | 0.57177 | 291.14 | 9.75 | | 126.14 |
| | | 0.03811 | | 0.47 | 68.20 | |
| 2½ | 0.8750 | 0.53366 | 302.70 | 9.28 | | 137.70 |
| | | 0.03811 | | 0.48 | 69.60 | |
| 2¾ | 0 9625 | 0.49555 | 314.80 | 8.80 | | 149.30 |
| | | 0.03811 | | 0.53 | 76.80 | |
| 3 | 1.0500 | 0.45744 | 327.90 | 8.27 | | 162.90 |
| | | 0.03811 | | 0.58 | 84.00 | |
| 3¼ | 1 1375 | 0.41933 | 337.46 | 7.69 | | 172.46 |
| | | 0.03811 | | 0.61 | 88.40 | |
| 3½ | 1.2250 | 0.38111 | 346.10 | 7.08 | | 181.10 |
| | | 0.03811 | | 0.62 | 90.00 | |
| 3¾ | 1.3125 | 0.34300 | 354.90 | 6.46 | | 189.90 |
| | | 0 03811 | | 0.67 | 97.10 | |
| 4 | 1.4000 | 0.30489 | 361.60 | 5.79 | | 196.60 |
| | | 0.03811 | | 0.68 | 98.60 | |
| 4¼ | 1.4875 | 0.26678 | 366.60 | 5.11 | | 201.64 |
| | | 0 03811 | | 0.70 | 101.50 | |
| 4½ | 1.5750 | 0.22867 | 371.10 | 4.41 | | 206.10 |
| | | 0.03811 | | 0.715 | 103.80 | |
| 4¾ | 1.6625 | 0.19056 | 376.10 | 3.695 | | 211.10 |
| | | 0.03811 | | 0.730 | 106.00 | |
| 5 | 1.7500 | 0.15245 | 378.30 | 2.965 | | 213.30 |
| | | 0.03811 | | 0.730 | 106.00 | |
| 5¼ | 1.8375 | 0.11434 | 380.66 | 2.235 | | 215.66 |
| | | 0.03811 | | 0.745 | 108.00 | |
| 5½ | 1.9250 | 0.07623 | 382.70 | 1.490 | | 217.70 |
| | | 0.03811 | | 0.745 | 108.00 | |
| 5¾ | 2.0125 | 0.03812 | 381.90 | 0.745 | | 216.90 |
| | | | | 0.745 | 108.00 | |
| 6 | 2.1000 | 0.0 | 381.70 | 0.0 | | 216.70 |

the difference immediately underneath. This trial figure is $\Delta V$, and is assumed to be destroyed instantaneously by the first movement of the gate. A pressure wave, $\Delta h$, of magnitude, $\frac{a\ \Delta\ v}{g} = \frac{4\,680}{32.2}(\Delta\ V) = 145\ \Delta\ V$, is therefore started up the pipe. The product of 145 $\Delta V$ is set down

in Column 6 opposite $\Delta V$. In Column 7 is recorded the algebraic sum of the values of $\Delta h$. Having obtained the figure in Column 7, it is added to the net head, $H_0 = 165$, and the sum is set down in the next line lower in Column 4. The result must now be checked, to see that $B\sqrt{H} = V$, where $B$ is 0.8766 and $H$ and $V$ have the values recorded in their respective columns opposite $B$. If the relation is not satisfied, a new trial value of $\Delta V$ must be chosen, and the operations repeated until a check is obtained. After trial, the initial value of $\Delta V$ was found to be 0.085. Proceeding in this way, the rise of pressure at the end of 0.35 sec. is found to be 56.80 ft. This rise has taken place in four successive jumps.

At this point it becomes necessary to trace the course of the pressure wave started up the penstock by the initial movement of the gate. This wave has a velocity of 4 680 ft. per sec., and travels at that rate toward the forebay or origin of the penstock; after arriving at the origin it is reflected and returns to the gate at the same velocity. The distance from gate to forebay and return is 1 640 ft., so that the pressure wave takes 0.35 sec. to cover this distance. On its arrival at the gate it is reflected immediately as a wave of sub-normal pressure, and commences its journey again from gate to forebay and back. At the instant the wave becomes sub-normal, however, the gate is given one of its instantaneous closing movements, causing a further reduction in the velocity of the water flowing in the penstock and the consequent rise of pressure incident thereto. Thus, at this instant, two factors have to be taken into consideration: the rise of pressure caused by the fifth little instantaneous movement of the gate and the fall in pressure caused by the change from super-normal to sub-normal of the pressure wave produced by the first or initial movement of the gate which occurred 0.35 sec. before.

By trial-and-error the velocity that has been destroyed by the fifth movement of the gate is found to be 0.258 ft. per sec., and the result is checked as follows. Multiplying 0.258 by 145, the magnitude of the resulting pressure wave is 37.4 ft., and this added to 56.80 would make the total excess pressure existing equal to 94.20 ft., were it not for the fact that the initial wave has returned to the gate and become sub-normal. The amount of the initial wave, as shown by the second line of Table 1, is 12.32, and since it not only falls to zero but passes below zero to a sub-normal pressure of equal amount, there must be subtracted

twice 12.32 from 94.20, making the net excess pressure existing at that instant 69.56 ft. Adding this to the initial net head $H_0 = 165$, the value of $V$ is checked as before by the formula, $V = B\sqrt{H}$.

Proceeding then as before, and remembering that the pressure rise caused by the sixth movement of the gate is reduced by the fall to sub-normal of the wave produced by the second movement of the gate, and the pressure rise of the seventh movement is reduced by the wave produced by the third movement, and so on, there may be calculated the successive increments of pressure.

For convenience, the time required by the pressure waves to travel from the gate to the origin of the pipe and return to the gate again will be called one interval. The interfering waves referred to in the foregoing paragraph are then always one interval apart.

After the eighth movement of the gate has taken place, it is found that the net excess pressure has reached 114.00 ft. At the instant the ninth movement takes place it must be noted that the pressure wave produced by the first movement of the gate, which has traveled, during the first interval, from the gate to the origin and back as a wave of super-normal pressure, and during the second interval over the same course as a wave of sub-normal pressure, has now returned to the gate and, again becoming super-normal, is again reflected and commences its journey from gate to origin and back. Thus, at the ninth movement of the gate, there must be taken into consideration the pressure wave caused by the instantaneous destruction of the velocity at that instant, the sub-normal wave due to the fifth movement, and the super-normal wave due to the first movement. After adding to the excess pressure existing at the end of the eighth movement, the rise of pressure caused by the ninth movement, there must be subtracted twice the pressure caused by the fifth movement, and there must be added twice the pressure caused by the first movement, or, in other words, there is subtracted twice the difference between the fifth and first waves.

By thus keeping in mind the position of the wave propagated by each movement of the gate, Table 1 may be completed, and the resulting maximum rise of pressure is found to be 217.70 ft.

Fig. 1 is a series of graphical diagrams showing the magnitude of the pressure waves caused by the successive instantaneous movements of the gate. A separate diagram is drawn for each movement, pressure being represented by the ordinates and time by the abscissas

The change from super-normal to sub-normal and *vice versa* is shown at the end of each interval of time. Fig. 2 is the excess pressure-time curve plotted from the figures in Column 7 of Table 1, or, what amounts to the same thing, from the algebraic sum of the pressure waves shown in Fig. 1.

Table 2 shows the method of determining the results when the recovery of friction in the penstock is included, an example being selected where the friction head is an appreciable quantity. The

TABLE 2.—By Arithmetic Integration.

Data: $L = 6\,337$ ft. $V_0 = 15.055$ ft. per sec. $H_0 = 1\,260$ ft. $T = 69.5$ sec. $a = 3\,647$ ft. per sec. Friction head $h_f = 81$ ft.

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|
| Interval. | Gate,* $B$. | Head, $H$. | Velocity, $V$. | $113\,\Delta V$. $\Delta h$. | $\Sigma\,\Delta h$. | $3\,574\,V^2$, $h_f$. | $\Delta h_f$. | $\Sigma(\Delta h + \Delta h_f)$. $h_t$. |
| 0 | 0.4241 | 1260.0 | 15.055 | | .... | 81.0 | .... | .... |
| | | | 0.155 | 17.5 | | | | |
| 1 | 0.4168 | 1279.2 | 14.90 | | 17.5 | 79.3 | 1.7 | 19.2 |
| | | | 0.29 | 32.8 | | | | |
| 2 | 0.4084 | 1279.8 | 14.61 | | 15.3 | 76.5 | 4.5 | 19.8 |
| | | | 0.28 | 31.7 | | | | |
| 3 | 0.3995 | 1284.0 | 14.33 | | 16.4 | 73.4 | 7.6 | 24.0 |
| | | | 0.33 | 37.3 | | | | |
| 4 | 0.3895 | 1291.8 | 14.00 | | 20.9 | 70.1 | 10.9 | 31.8 |
| | | | 0.37 | 41.8 | | | | |
| 5 | 0.3784 | 1295.5 | 13.63 | | 20.9 | 66.4 | 14.6 | 35.5 |
| | | | 0.42 | 47.5 | | | | |
| 6 | 0.3657 | 1305.3 | 13.21 | | 26.6 | 62.3 | 18.7 | 45.3 |
| | | | 0.49 | 55.4 | | | | |
| 7 | 0.3513 | 1311.8 | 12.72 | | 28.6 | 58.0 | 23.0 | 51.8 |
| | | | 0.53 | 59.8 | | | | |
| 8 | 0.3354 | 1319.0 | 12.19 | | 31.0 | 53.0 | 28.0 | 59.0 |
| | | | 0.60 | 67.8 | | | | |
| 9 | 0.3180 | 1329.8 | 11.59 | | 36.8 | 48.0 | 33.0 | 69.8 |
| | | | 0.65 | 73.5 | | | | |
| 10 | 0.2991 | 1334.9 | 10.94 | | 36.7 | 42.8 | 38.2 | 74.9 |
| | | | 0.72 | 81.3 | | | | |
| 11 | 0.2781 | 1348.2 | 10.22 | | 44.6 | 37.4 | 43.6 | 88.2 |
| | | | 0.84 | 94.8 | | | | |
| 12 | 0.2544 | 1359.7 | 9.38 | | 50.2 | 31.5 | 49.5 | 99.7 |
| | | | 0.92 | 104.0 | | | | |
| 13 | 0.2285 | 1369.2 | 8.46 | | 53.8 | 25.6 | 55.4 | 109.2 |
| | | | 0.97 | 109.5 | | | | |
| 14 | 0.2009 | 1376.6 | 7.49 | | 55.7 | 20.1 | 60.9 | 116.6 |
| | | | 1.07 | 121.0 | | | | |
| 15 | 0.1719 | 1391.6 | 6.42 | | 65.3 | 14.7 | 66.3 | 131.6 |
| | | | 1.15 | 130.0 | | | | |
| 16 | 0.1411 | 1395.8 | 5.27 | | 64.7 | 9.9 | 71.1 | 135.8 |
| | | | 1.21 | 136.8 | | | | |
| 17 | 0.1083 | 1407.2 | 4.06 | | 72.1 | 5.9 | 75.1 | 147.2 |
| | | | 1.33 | 150.1 | | | | |
| 18 | 0.0725 | 1416.3 | 2.73 | | 78.0 | 2.7 | 78.3 | 156.3 |
| | | | 1.365 | 154.2 | | | | |
| 19 | 0.0363 | 1416.5 | 1.365 | | 76.2 | 0.7 | 80.3 | 156.5 |
| | | | 1.365 | 154.2 | | | | |
| 20 | 0. | 1419.0 | 0. | | 78.0 | 0. | 81.0 | 159.0 |

* Non-uniform gate motion.

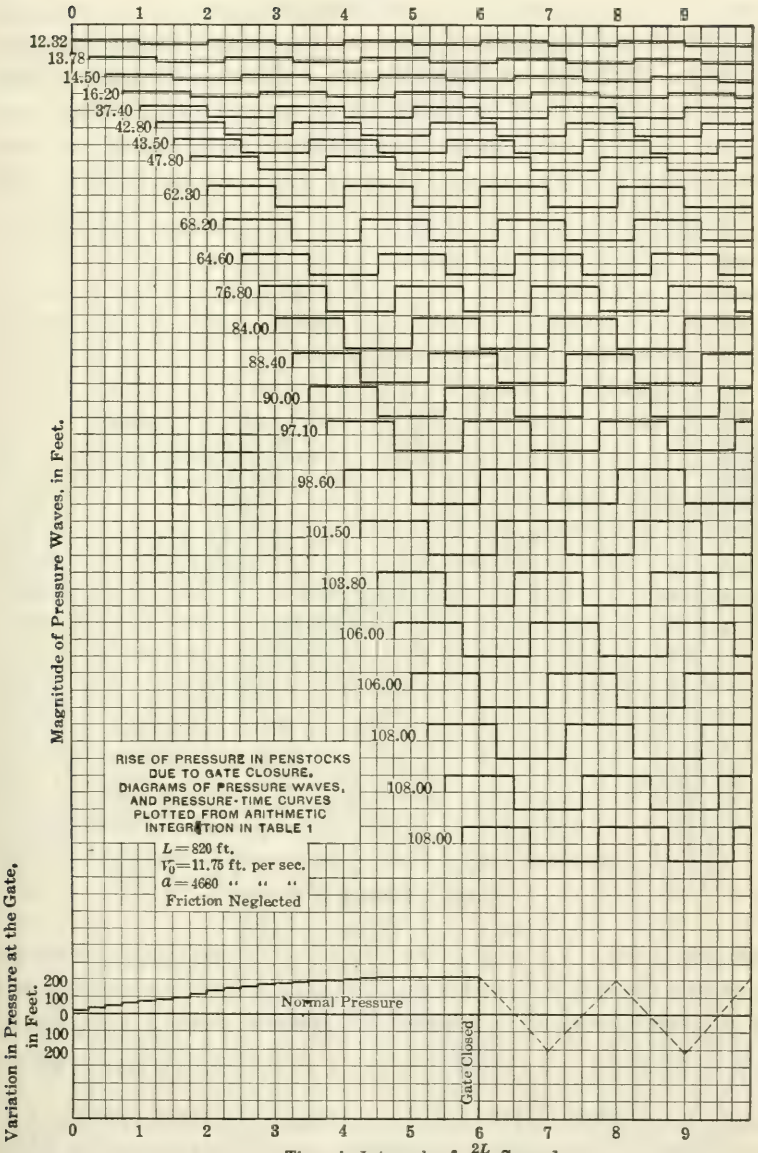
0 1 2 3 4 5 6 7 8 9
12.32
13.78
14.50
16.20
37.40
42.80
43.50
47.80
62.30
68.20
64.60
76.80
84.00
88.40
90.00
97.10
98.60
101.50
103.80
106.00
106.00
108.00
108.00
108.00
Magnitude of Pressure Waves, in Feet.
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE. DIAGRAMS OF PRESSURE WAVES, AND PRESSURE-TIME CURVES PLOTTED FROM ARITHMETIC INTEGRATION IN TABLE 1
L = 820 ft.
V0 = 11.75 ft. per sec.
a = 4680 " " "
Friction Neglected
Variation in Pressure at the Gate, in Feet.
200
100
0
100
200
Normal Pressure
Gate Closed
0 1 2 3 4 5 6 7 8 9
Time, in Intervals of 2L/a Seconds.

FIG. 1.

operations are almost identical with those just described, up to Columns 6 and 7. To avoid reference to the foregoing, however, the formation of Table 2 will be described from the beginning. In the first line, opposite $B = 0.4241$, set down Columns 3, 4, and 7, the known values of $H_0$, $V_0$, and $h_f$ (friction head). Next, assume a trial reduction in velocity, caused by the initial instantaneous movement of the gate, and set the figures down in Column 4 under the value of $V_0$, and

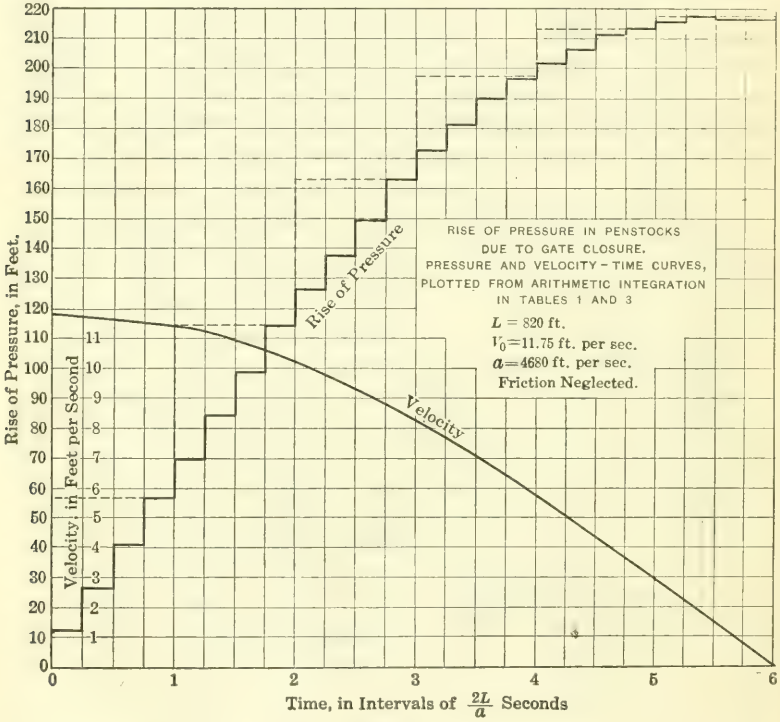
Rise of Pressure, in Feet.
Velocity, in Feet per Second
Time, in Intervals of $\frac{2L}{a}$ Seconds
Rise of Pressure
Velocity
RISE OF PRESSURE IN PENSTOCKS
DUE TO GATE CLOSURE.
PRESSURE AND VELOCITY - TIME CURVES,
PLOTTED FROM ARITHMETIC INTEGRATION
IN TABLES 1 AND 3
$L$ = 820 ft.
$V_0$=11.75 ft. per sec.
$a$=4680 ft. per sec.
Friction Neglected.

FIG. 2.

subtract it from $V_0$, placing the difference immediately underneath. This trial figure is $\Delta V$, and is assumed to be destroyed instantaneously by the first movement of the gate. A pressure wave, $\Delta h$, of magnitude $= \frac{(\Delta V)\, a}{g} = (\Delta V)\, \frac{3647}{32.2} = 113\ \Delta V$, therefore, is started up the pipe. The product of $113\ \Delta V$ is set down in Column 5 opposite $\Delta V$. In Column 6 is recorded the algebraic sum of the values of $\Delta h$. In Column 7 the total friction head, due to the velocity shown in Column 4, is set down, and, in Column 8, the friction head recovered at each

operation is shown. For convenience, $h_f$ may be made equal to $F\ V^2$, in which $F$ is a coefficient obtained from the known values at the beginning. In the example, $F = 0.3574$. Column 9 shows the sum of the opposite items in Columns 6 and 8. Having obtained the figure in Column 9, it is added to the net head, $H_0 = 1\,260$, and the sum is set down in the next lower line in Column 3. The result must now be checked, to see that $B \sqrt{H} = V$, where $B$ is now 0.4168, and $H$ and $V$ are the values opposite. If the relation is not satisfied, a new trial value of $\Delta V$ must be chosen, and the operations repeated until a check is obtained. After trial, the initial value of $\Delta V$ was found to be 0.155. The operations for obtaining the figures on the third line are not quite the same as those just described, because, after assuming the next trial value of $\Delta V$, and multiplying it by 113, it must be remembered that the resulting pressure at the gate is reduced by the return of the first wave, which has traveled up to the forebay and back, and now changes to sub-normal and repeats the journey. The time at which the gate is given its second movement has been selected purposely to coincide with the return of the first wave. The item opposite Interval 2, in Column 6, therefore, is the difference between the first two figures in Column 5. The other operations are similar to those already described, and the resulting figures in Columns 3 and 4 are checked similarly with the value of $B = 0.4084$. The succeeding lines are filled in by the same process, always keeping in mind the return of the preceding waves, and whether they change to sub-normal or super-normal. A little study will disclose the fact that the figure in the second line of Column 6 may be obtained by subtracting the figure in the first line of Column 6 from the figure in the second line of Column 5. Similarly, the figure in the third line of Column 6 may be obtained by subtracting the figure in the second line of Column 6 from the figure in the third line of Column 5, and so on.

At this point it is interesting to repeat the trial-and-error work for the foregoing example worked out in Table 1, but using only 6 instantaneous movements of the gate instead of 24. The results are shown in Table 3, and the pressure-time curve in dotted lines in Fig. 2. From these it will be noted that the total rise of pressure is the same as that obtained by the calculations for 24 movements, and, moreover, the resulting pressure at the end of each interval is the same in both cases. Although six movements of the gate, or one movement to each

TABLE 3.—By Arithmetic Integration.
For Data, see Table 1.

| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|
| Interval. | Time, $T$. | Gate, $B$. | Head, $H$. | Velocity, $V$. | $145\ \Delta\ V$, $\Delta\ h$. | $\Sigma\ (\Delta\ h)$, $h_t$. |
| 0 | 0.0 | 0.91476 | 165.00 | 11.75 | | ..... |
| | | | | 0.392 | 56.8 | |
| 1 | 0.35 | 0.762 | 221.8 | 11.358 | | 56.8 |
| | | | | 1.178 | 171.0 | |
| 2 | 0.70 | 0.608 | 279.2 | 10.18 | | 114.2 |
| | | | | 1.91 | 277.0 | |
| 3 | 1.05 | 0.457 | 327.8 | 8.27 | | 162.8 |
| | | | | 2.48 | 360.0 | |
| 4 | 1.40 | 0.304 | 362.20 | 5.79 | | 197.2 |
| | | | | 2.825 | 410.0 | |
| 5 | 1.75 | 0.1525 | 377.8 | 2.965 | | 212.8 |
| | | | | 2.965 | 430.0 | |
| 6 | 2.10 | 0.0 | 382.2 | 0.00 | | 217.2 |

interval of time, are sufficient to determine the pressure rise at the end of each interval, it requires the larger number of movements to obtain intermediate points on the pressure-time curve. If a still greater number of movements is taken, the increments in pressure rise become smaller, and, in the limit, the stepped diagrams similar to Fig. 2 would become a series of smooth curves from the beginning to the end of each interval. The diagram, however, would not necessarily form a smooth curve from the beginning to the end of the closing time, because cusps or changes of curvature at the end of each interval result from the action of the pressure waves in changing at that instant from super-normal to sub-normal or *vice-versa*. When the duration of closure is short, the change of curvature in the diagram at the end of each interval is frequently very apparent; but, when the duration of closure is long, the changes of curvature in many cases cannot be detected by the eye. These changes of curvature at the end of the intervals make it difficult to formulate the integration which can so easily be performed by the trial-and-error work already explained.

It is possible, however, to obtain a series of equations, one for each interval of the closing time, that constitute a direct mathematical solution of the problem, without recourse to trial-and-error methods. The foregoing example has been explained in order that the analytical work may be more easily understood, and in order that the method of tracing the course of the pressure waves and keeping track of their periodic changes may be kept clearly in mind. More particularly, it should

be borne in mind that though a formula may be written for the pressure rise in the first interval, using only the known quantities existing before the shut-down, the formulas for the pressure rise in any succeeding interval will involve, as one of the known quantities, the value of the pressure rise at the end of the preceding interval. It thus becomes necessary, when calculating the pressure rise at any time during, or at the end of, the closing of the gate, to obtain first the amount of the pressure rise at the end of each preceding interval. Moreover, if it is desired to determine the pressure rise at any time between the beginning and end of any interval—that is, at any fractional part of an interval—not only is it necessary to determine the pressure rise at the end of each preceding interval, but also the pressure rise at the same fractional part of each preceding interval. This also applies in determining the excess pressure-time curve when the duration of closure is not exactly a whole number of intervals.

NOMENCLATURE.

$L$ = length of penstock, in feet;

$a$ = velocity of pressure wave, in feet per second;

$g$ = acceleration due to gravity, in feet per second per second;

$\frac{2L}{a}$ = one interval of time;

$T$ = governor time, in seconds, *i. e.*, total duration of gate closure;

$T_1, T_2, T_3, \ldots T_n$ = time at the end of the 1st, 2d, 3d, .... $n$th interval;

$t_1, t_2, t_3, \ldots t_n$ = any time during the 1st, 2d, 3d, .... $n$th interval;

$n$ = any number of intervals; the final interval in the time, $T$, need not be complete;

$H_0$ = normal net head, in feet;

$h_1, h_2, h_3, \ldots h_n$ = excess pressure above normal, in feet, existing at the end of the 1st, 2d, 3d, .... $n$th interval, *i, e.*, at the times, $T_1, T_2, T_3, \ldots T_n$;

$h_{t_1}, h_{t_2}, h_{t_3}, \ldots h_{t_n}$ = excess pressure above normal, in feet, at any time during the 1st, 2d, 3d, ....$n$th interval, *i. e.*, at the times, $t_1, t_2, t_3, \ldots t_n$;

$V_0$ = initial velocity, in feet per second, of the water in the penstock before shut-down.

$V_1, V_2, V_3, \ldots V_n$ = velocity, in feet per second, of the water in the penstock at the end of the 1st, 2d, 3d, .... $n$th interval;

$V_{t_1}, V_{t_2}, V_{t_3}, \ldots V_{t_n}$ = velocity, in feet per second, of the water in the penstock at any time, $t_1, t_2, t_3, \ldots t_n$, during the 1st, 2d, 3d, .... $n$th interval;

$B_0 = \sqrt{\frac{V_0}{H_0}}$ = a number representing the gate opening;

$$S_{t_1} = \left(\frac{a}{g}\right)^2 \left(1 - \frac{t_1}{T}\right)^2 B_0^2 \qquad R_0 = \frac{a}{g} V_0$$

$$S_{t_2} = \left(\frac{a}{g}\right)^2 \left(1 - \frac{t_2}{T}\right)^2 B_0^2 \qquad R_{t_1} = h_1 + \frac{a}{g} V_1 - C_{t_1}$$

$$S_{t_n} = \left(\frac{a}{g}\right)^2 \left(1 - \frac{t_n}{T}\right)^2 B_0^2 \qquad R_{t_2} = h_2 + \frac{a}{g} V_2 - C_{t_2}$$

$$C_{t_1} = 2\frac{a}{g}(V_0 - V_{t_1}) \qquad R_{t_{n-1}} = h_{n-1} + \frac{a}{g} V_{n-1} - C_{t_{n-1}}$$

$$C_{t_2} = 2\frac{a}{g}(V_1 - V_{t_2}) - C_{t_1} \qquad Z_1 = \frac{\left(\frac{a}{g}\right)^2 S_{t_1}}{\left(\frac{a}{g}\right)^2 + S_{t_1} F}$$

$$C_{t_n} = 2\frac{a}{g}(V_{n-1} - V_{t_n}) - C_{t_{n-1}}$$

$F$ = a friction factor such that $F V^2$ = total loss, in feet of head, for velocity, $V$;

$$Z_2 = \frac{\left(\frac{a}{g}\right)^2 S_{t_2}}{\left(\frac{a}{g}\right)^2 + S_{t_2} F}$$

$$Z_n = \frac{\left(\frac{a}{g}\right)^2 S_{t_n}}{\left(\frac{a}{g}\right)^2 + S_{t_n} F}$$

Time is always to be measured from the beginning of the gate movement. Thus, the time, $t_2$, is the time from the beginning of the stroke to some time between the first and third intervals. The successive values of $t_1$, $t_2$, etc., must always be one interval apart.

*First: Derivation of Formulas with Friction Neglected.*—Joukovsky's formula for water-hammer, as already stated in Equation (1), is:

$$h = \frac{a V}{g}$$

During slow closing of the gate, $d\,h = \frac{a}{g}\,d\,V$.

At the beginning of the closing time, as already stated in Equation (3),

$$V_0 = B_0\,\sqrt{H_0}$$

and, in general, $V = B\,\sqrt{H_0 + h}$.

For the first interval:

$$\int_0^{h_{t_1}} d\,h = \frac{a}{g}\int_{V_{t_1}}^{V_0} d\,V$$

where $h_{t_1}$ = pressure rise at any time, $t_1$, during the first interval, and $V_{t_1}$ = velocity at the time, $t_1$, during the first interval.

Integrating, then:

$$h_{t_1} = \frac{a}{g}\,(V_0 - V_{t_1}) \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Since $V_{t_1}$ must be proportional to the gate opening multiplied by the square root of the head, then, for uniform gate motion:

$$V_{t_1} = \left(1 - \frac{t_1}{T}\right) B_0\,\sqrt{H_0 + h_{t_1}} \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Substituting this value of $V_{t_1}$ in the equation for $h_{t_1}$, the latter becomes:

$$h_{t_1} = \frac{a}{g}\,V_0 - \frac{a}{g}\left(1 - \frac{t_1}{T}\right) B_0\,\sqrt{H_0 + h_{t_1}}$$

For simplicity, substitute the symbol, $R_0$, in place of $\frac{a}{g}\,V_0$, and the Symbol, $\sqrt{S_{t_1}}$, for $\frac{a}{g}\left(1 - \frac{t_1}{T}\right) B_0$.

Thus: $h_{t_1} = R_0 - \sqrt{S_{t_1}\,(H_0 + h_{t_1})}$

Squaring: $(h_{t_1} - R_0)^2 = S_{t_1}\,(H_0 + h_{t_1})$

Expanding: $h_{t_1}^{\,2} - 2\,h_{t_1}\,R_0 + R_0^{\,2} = S_{t_1}\,H_0 + S_{t_1}\,h_{t_1}$

Collecting: $h_{t_1}^{\,2} - h_{t_1}\,(S_{t_1} + 2\,R_0) + R_0^{\,2} - S_{t_1}\,H_0 = 0$

Solving: $h_{t_1} = \frac{1}{2}\left\{(S_{t_1} + 2\,R_0) \pm \sqrt{(S_{t_1} + 2\,R_0)^2 - 4\,R_0^{\,2} + 4\,S_{t_1}\,H_0}\right\}$

Simplifying: $h_{t_1} = \frac{1}{2}\left\{(S_{t_1} + 2\,R_0) \pm \sqrt{S_{t_1}\,(S_{t_1} + 4\,R_0 + 4\,H_0)}\right\} \ldots . (7)$

For the second interval, an examination of Table 1 will show that

$$\int_0^{h_{t_2}} d\,h = \frac{a}{g}\int_{V_{t_2}}^{V_1} d\,V + h_1 - 2\,\frac{a}{g}\int_{V_{t_1}}^{V_0} d\,V$$

Where $h_{t_2}$ = pressure rise at any time, $t_2$, during the second interval;
$V_{t_2}$ = velocity at the time, $t_2$;
$V_1$ = velocity at the end of the first interval;
$h_1$ = pressure rise at the end of the first interval;
$V_{t_1}$ = velocity at the time, $t_1$, which must be exactly one interval before the time, $t_2$.

Integrating: then $h_{t_2} = \frac{a}{g}(V_1 - V_{t_2}) + h_1 - 2\frac{a}{g}(V_0 - V_{t_1})$....(8)

Substituting $C_{t_1}$ for $2\frac{a}{g}(V_0 - V_{t_1})$

$$h_{t_2} = \frac{a}{g}(V_1 - V_{t_2}) + h_1 - C_{t_1}$$

Again, since $V_{t_2}$ must be proportional to the gate opening multiplied by the square root of the head, then, for uniform gate motion:

$$V_{t_2} = \left(1 - \frac{t_2}{T}\right) B_0 \sqrt{H_0 + h_{t_2}} \quad \ldots\ldots\ldots\ldots (9)$$

Substituting this value of $V_{t_2}$ in the equation for $h_{t_2}$ the latter becomes

$$h_{t_2} = \frac{a}{g} V_1 - \frac{a}{g}\left(1 - \frac{t_2}{T}\right) B_0 \sqrt{H_0 + h_{t_2}} + h_1 - C_{t_1}.$$

Substituting the symbol, $R_{t_1}$, in place of $\frac{a}{g} V_1 + h_1 - C_{t_1}$, and the symbol, $\sqrt{S_{t_2}}$, for $\frac{a}{g}\left(1 - \frac{t_2}{T}\right) B_0$,

$$h_{t_2} = R_{t_1} - \sqrt{S_{t_2}(H_0 + h_{t_2})}$$

Squaring: $(h_{t_2} - R_{t_1})^2 = S_{t_2}(H_0 + h_{t_2})$

Expanding: $h_{t_2}^2 - 2 h_{t_2} R_{t_1} + R_{t_1}^2 = S_{t_2} H_0 + S_{t_2} h_{t_2}$

Collecting: $h_{t_2}^2 - h_{t_2}(S_{t_2} + 2 R_{t_1}) + R_{t_1}^2 - S_{t_2} H_0 = 0$

Solving: $h_{t_2} = \frac{1}{2}\left\{(S_{t_2} + 2 R_{t_1}) \pm \sqrt{(S_{t_2} + 2 R_{t_1})^2 - 4 R_{t_1}^2 + 4 S_{t_2} H_0}\right\}$

Simplifying: $h_{t_2} = \frac{1}{2}\left\{(S_{t_2} + 2 R_{t_1}) \pm \sqrt{S_{t_2}(S_{t_2} + 4 R_{t_1} + 4 H_0)}\right\}$..(10)

In a similar manner, the value of $h$, at any time in any interval, may be found.

*Second: Derivation of Formulas with Friction Included.*—In the foregoing analysis no account has been taken of the effect of frictional losses of head in the penstock. As the velocity in the penstock is gradually destroyed, the friction head is gradually recovered and is

added to the net head, producing discharge through the turbine gates. In any penstock the total frictional losses may be assumed to be proportional to the square of the velocity of flow, and may be represented by a coefficient, $F$, such that $FV^2 =$ total loss in feet of head for a velocity, $V$. The velocity head recovered at any time in the first interval, therefore, is $F\,V_0^2 - F\,V_{t_1}^2$. This head must then be added to the sum of $H_0 + h_{t_1}$, in determining the relation between velocity, gate opening, and head, as given by Equation (6).

Thus: $$V_{t_1} = \left(1 - \frac{t_1}{T}\right) B_0 \sqrt{H_0 + h_{t_1} + F\,V_0^2 - F\,V_{t_1}^2}$$

Squaring: $$V_t^2 = \left(1 - \frac{t_1}{T}\right)^2 B_0^2 (H_0 + h_{t_1} + F\,V_0^2 - F\,V_{t_1}^2)$$

Collecting: $$V_{t_1}^2 \left\{1 + \left(1 - \frac{t_1}{T}\right)^2 B_0^2 F\right\} = \left(1 - \frac{t_1}{T}\right)^2 B_0^2 (H_0 + h_{t_1} + F\,V_0^2)$$

Solving, and multiplying numerator and denominator by $\frac{a}{g}$:

$$V_{t_1} = \sqrt{\frac{\left(\frac{a}{g}\right)^2 \left(1 - \frac{t_1}{T}\right)^2 B_0^2 (H_0 + h_{t_1} + F\,V_0^2)}{\left(\frac{a}{g}\right)^2 + \left(\frac{a}{g}\right)^2 \left(1 - \frac{t_1}{T}\right)^2 B_0^2 F}}$$

Substituting $S_{t_1}$ for $\left(\frac{a}{g}\right)^2 \left(1 - \frac{t_1}{T}\right)^2 B_0^2$,

$$V_{t_1} = \sqrt{\frac{S_{t_1} (H_0 + h_{t_1} + F\,V_0^2)}{\left(\frac{a}{g}\right)^2 + S_{t_1} F}} \qquad \ldots\ldots\ldots\ldots (11)$$

Inserting this value of $V_{t_1}$ in Equation (5) for $h_{t_1}$,

Then: $$h_{t_1} = \frac{a}{g} V_0 - \frac{a}{g} \sqrt{\frac{S_{t_1} (H_0 + h_{t_1} + F\,V_0^2)}{\left(\frac{a}{g}\right)^2 + S_{t_1} F}}$$

Solving for $h_{t_1}$ in the same manner as that used in obtaining Equation (7), and substituting $R_0$ in place of $\frac{a}{g} V_0$, and $Z_1$ in place of

$$\frac{\left(\frac{a}{g}\right)^2 S_{t_1}}{\left(\frac{a}{g}\right)^2 + S_{t_1} F},$$

Then: $$h_{t_1} = \frac{1}{2}\left\{(2R_0 + Z_1) \pm \sqrt{Z_1^2 + 4Z_1(R_0 + H_0 + FV_0^2)}\right\} \quad ..(12)$$

In a similar manner, the equation for $h_{t_2}$ is obtained by adding $FV_0^2 - FV_{t_2}^2$ under the root sign in Equation (9) and inserting the resulting value of $V_{t_2}$ in Equation (8). Without performing the operations, which are similar to the above, the result may be written down at once.

$$h_{t_2} = \frac{1}{2}\left\{(2R_{t_1} + Z_2) \pm \sqrt{Z_2^2 + 4Z_2(R_{t_1} + H_0 + FV_0^2)}\right\} \quad ..(13)$$

Where: $$R_{t_1} = \left(\frac{a}{g}V_1 + h_1 - C_{t_1}\right)$$

$$C_{t_1} = \frac{2a}{g}(V_0 - V_{t_1})$$

$$Z_2 = \frac{\left(\frac{a}{g}\right)^2 S_{t_2}}{\left(\frac{a}{g}\right)^2 + S_{t_2}F}$$

and $$S_{t_2} = \left(\frac{a}{g}\right)^2\left(1 - \frac{t_2}{T}\right)^2 B_0^2$$

Similarly, the value of $h$, at any time in any interval, may be found.

When the gate motion is not uniform, the value of $S_t$ has to be made equal to $x^2\left(\frac{a}{g}\right)^2 B_0^2\left(1 - \frac{t}{T}\right)^2$, where $x$ is a constant or variable coefficient, which may be determined by plotting the curve of gate opening on a time base. For uniform motion, the curve would be a straight line, the ordinate of which, at any time, $t$, is $\left(1 - \frac{t}{T}\right)B_0$. For any other than uniform motion, the ordinates of the straight line would be multiplied by the constant or variable, $x$, which, if the motion varied in a regular manner, might sometimes be expressed in terms of $t$, either graphically or analytically, from the known relation between the governor movements and the gate opening. If the motion were not regular, a graphical solution only could be obtained.

Tables 4 and 5 show the values of $h_t$ obtained by using the formulas in the examples worked out by arithmetic integration in Tables 1, 2, and 3.

It should be noted here, by way of caution, that, in calculating the value of $h$, the two terms inside the larger brackets of the foregoing formulas are frequently so large and their difference so small as to make it necessary to perform the work by logarithms. The correct result cannot be obtained in such cases by using an ordinary 10-in. slide-rule.

TABLE 4.—By Formulas.

Data: $L = 820$ ft. $V_0 = 11.75$ ft. per sec. $H_0 = 165$ ft. $T = 2.1$ sec. $a = 4\,680$ ft. per sec. Friction neglected.

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| Interval. | Gate, $B$. | Rise of pressure, $h_t$. | Velocity, $V$. |
| 0 | 0.9148 | 0.0 | 11.7500 |
| ¼ | 0.8766 | 12.12 | 11.6664 |
| ½ | 0.8385 | 25.53 | 11.5740 |
| ¾ | 0.8004 | 40.41 | 11.4713 |
| 1 | 0.7623 | 56.96 | 11.3571 |
| 1¼ | 0.7242 | 69.94 | 11.1004 |
| 1½ | 0.6861 | 83.72 | 10.8205 |
| 1¾ | 0.6480 | 98.31 | 10.5149 |
| 2 | 0.6099 | 113.63 | 10.1805 |
| 2¼ | 0.5718 | 125.78 | 9.7505 |
| 2½ | 0.5337 | 138.05 | 9.2909 |
| 2¾ | 0.4956 | 150.32 | 8.8005 |
| 3 | 0.4574 | 162.42 | 8.2766 |
| 3¼ | 0.4193 | 171.97 | 7.6970 |
| 3½ | 0.3811 | 181.10 | 7.0899 |
| 3¾ | 0.3430 | 189.43 | 6.4574 |
| 4 | 0.3049 | 196.77 | 5.7994 |
| 4¼ | 0.2668 | 202.49 | 5.1146 |
| 4½ | 0.2287 | 207.14 | 4.4118 |
| 4¾ | 0.1906 | 211.00 | 3.6959 |
| 5 | 0.1525 | 213.79 | 2.9680 |
| 5¼ | 0.1143 | 215.75 | 2.2303 |
| 5½ | 0.0762 | 216.71 | 1.4887 |
| 5¾ | 0.0381 | 216.95 | 0.7446 |
| 6 | 0.0 | 216.57 | 0.0 |

It is now interesting and instructive to compare the results given by the foregoing formulas with those given by other formulas which have been proposed to determine the rise of pressure caused by gradually stopping the flow of water in pipes. For this purpose Fig. 3 has been prepared. There are three such fundamentally different formulas known to the writer, namely, those of Mr. L. Allievi,* M. M Warren,†

* The writer was unable to obtain an English translation of Mr. Allievi's paper, but his formula is commonly given as follows:

$$h = \frac{N H}{2} + H\sqrt{\frac{N^2}{4} + N}$$

Where $h$ = rise of pressure, in feet, above normal;
$H$ = normal net head, in feet;
$N = \left(\frac{L V}{g T H}\right)^2$;
$L$ = length of penstock, in feet;
$V$ = velocity of water in penstock, in feet per second;
$T$ = duration of gate closure, in seconds;
$g$ = acceleration due to gravity, in feet per second per second.

† *Transactions*, Am. Soc. C. E., Vol. LXXIX, pp. 238, 242. Mr. Warren's formula is:

$h = \frac{L V}{g}\left(T - \frac{L}{a}\right)$, where $a$ = velocity of the pressure wave, and the other symbols have the same significance as in this paper.

TABLE 5.—By Formulas.

Data: $L = 6\,337$ ft. $V_0 = 15.055$ ft. per sec. $H_0 = 1\,260$ ft. $T = 69.5$ sec. $a = 3\,647$ ft. per sec. Friction head, $h_f = 81$ ft.

Non-uniform Gate Motion.

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| Interval. | Gate, $B$. | Rise of pressure. | Velocity. |
| 0 | 0.4241 | 0. | 15.0550 |
| 1 | 0.4168 | 18.68 | 14.9040 |
| 2 | 0.4084 | 20.42 | 14.6137 |
| 3 | 0.3995 | 25.04 | 14.3210 |
| 4 | 0.3895 | 30.74 | 13.9931 |
| 5 | 0.3784 | 36.52 | 13.6251 |
| 6 | 0.3657 | 44.12 | 13.2063 |
| 7 | 0.3513 | 52.07 | 12.7250 |
| 8 | 0.3354 | 59.96 | 12.1854 |
| 9 | 0.3180 | 68.27 | 11.5898 |
| 10 | 0.2991 | 76.53 | 10.9388 |
| 11 | 0.2781 | 87.85 | 10.2097 |
| 12 | 0.2544 | 99.30 | 9.3792 |
| 13 | 0.2285 | 110.13 | 8.4551 |
| 14 | 0.2009 | 118.88 | 7.4606 |
| 15 | 0.1719 | 128.15 | 6.4024 |
| 16 | 0.1411 | 136.68 | 5.2746 |
| 17 | 0.1083 | 146.75 | 4.0599 |
| 18 | 0.0725 | 156.94 | 2.7301 |
| 19 | 0.0363 | 156.13 | 1.3638 |
| 20 | 0.0 | 159.21 | 0. |

Assoc. M. Am. Soc. C. E., and H. C. Vensano,* M. Am. Soc. C. E. The formula by Allievi gives the maximum excess pressure caused by stopping the flow of a column of water, assumed as an incompressible fluid, moving in an inextensible pipe, and neglecting the effect of friction. Mr. R. D. Johnson,† Mr. A. H. Gibson,‡ and W. F.

* *Transactions*, Am. Soc. C. E., Vol. LXXIX, pp. 289–299; and Vol. LXXXII, p. 185. Mr. Vensano's formula is:

$h = \frac{2 L V}{g T}$ with the limitation that $h$ can never be greater than $\frac{V a}{g}$.

† *Transactions*, Am. Soc. C. E., Vol. LXXIX, pp. 277–281. Mr. Johnson's formula is:

$$H_{\max.} = \frac{2 M Y}{N^2}\left(M + \sqrt{M^2 + N^2}\right)$$

where $H_{\max.}$ $M = L V$ = maximum rise of pressure, in feet, above normal;
and $N = 2 g Y T$, in which $Y$ is the normal net head in feet, and the other symbols have the same significance as in this paper.

‡ "Water Hammer in Hydraulic Pipe Lines", by A. H. Gibson. Mr. Gibson's formula is: (In order to prevent confusion with the foregoing, some changes have been made in the nomenclature):

$$p' = \frac{w}{g}\left[\left(\frac{L}{A}\cdot\frac{A_1}{T}\right)^2 + \frac{L}{A}\cdot\frac{A_1}{T}\sqrt{2 g H + \left(\frac{L}{A}\cdot\frac{A_1}{T}\right)^2}\right]$$

where $p'$ = rise in pressure, in pounds per square foot, behind the valve at the instant when closure is complete, and therefore when $p$ is maximum;
$A$ = cross-sectional area of penstock, in square feet;
$A_1$ = maximum effective area of valve opening, in square feet;
$w$ = weight of a cubic foot of water;
and the other symbols have the same significance as in this paper.

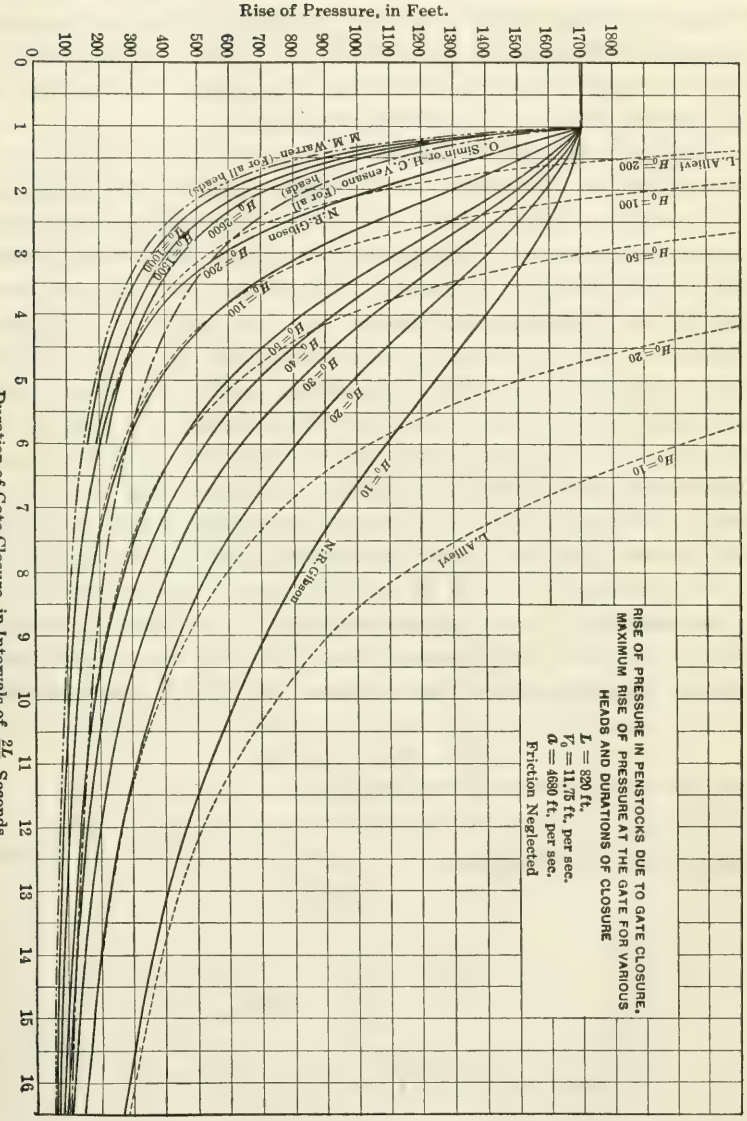
Rise of Pressure, in Feet.
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Duration of Gate Closure, in Intervals of $\frac{2L}{a}$ Seconds
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE, MAXIMUM RISE OF PRESSURE AT THE GATE FOR VARIOUS HEADS AND DURATIONS OF CLOSURE.
$L$ = 820 ft.
$V_0$ = 11.75 ft. per sec.
$a$ = 4680 ft. per sec.
Friction Neglected
L. Allievi
$H_0$ = 10
$H_0$ = 20
$H_0$ = 50
$H_0$ = 100
$H_0$ = 200
N. R. Gibson
$H_0$ = 10
$H_0$ = 20
$H_0$ = 30
$H_0$ = 50
$H_0$ = 100
$H_0$ = 200
M. R. Gibson (For all Heads)
O. Simin or H. C. Vennano (For all Heads)
M. M. Warren (For all Heads)
L. Allievi
$H_0$ = 200
$H_0$ = 100
$H_0$ = 50
$H_0$ = 20
$H_0$ = 10

FIG. 3.

Uhl,* M. Am. Soc. C. E., have each presented a similar formula, with different nomenclature and somewhat differently arranged, but all give the same result as Allievi's formula. Mr. Johnson has also presented a method of determining the pressure-time curve resulting from the same assumption,† and Mr. A. H. Gibson has shown how friction may be taken into account by successive calculations.‡

The limitations of the Allievi formula are well known to these authors, as they specifically refer to them; they are known, also, no doubt, to many others who use that formula, because it is readily seen that, for zero duration of closure, the formula gives an infinite pressure rise, and this cannot be so because the finite value of maximum water-hammer, for instantaneous closure, has been proved by Professor Joukovsky. Allievi's formula takes into account the effect of the net head on the phenomena that occur during closure. In Fig. 3, there are shown in dotted lines a series of Allievi curves for various heads, and, for the data assumed, these show the maximum rises of pressure as ordinates, and durations of closure as abscissas. For convenience, the time abscissas have been marked off in intervals, instead of seconds. The curves, it will be noted, become very steep as the duration of closure becomes short, and, in the limit, appear to approach infinity as the duration of closure approaches zero. For low heads Joukovsky's limit of maximum water-hammer is passed by these curves at points of relatively long duration of gate closure. In Fig. 3, a similar series

* *Transactions*, Am. Soc. Mech. Engrs., Paper No. 1354. Mr. Uhl's formula is:

$$\frac{DH}{H} = \frac{n}{2}\left(n + \sqrt{n^2+4}\right)$$

where $DH$ = rise of pressure, in feet, above normal;

$$n = \frac{LV}{gTH}$$, in which the symbols have the same significance as in this paper.

† *Transactions*, Am. Soc. C. E., Vol. LXXIX, pp. 277–281. Mr. Johnson's formulas, to be solved as indicated in his discussion, are:

$$t = T\left\{\frac{\sqrt[n]{x}-1}{\sqrt[n]{x}}\right\}$$

where $x = R\left\{\frac{H+\sqrt{y_0}}{J-\sqrt{y_0}}\right\}$, $R$ being $\frac{J-\sqrt{Y}}{H+\sqrt{Y}}$,

and $n = \sqrt{\left(\frac{2gTY}{LV}\right)^2+1}$, $\quad H = \frac{LV}{2gT\sqrt{Y}}(n-1)$,

$$J = \frac{LV}{2gT\sqrt{Y}}(n+1)$$

‡ "Water Hammer in Hydraulic Pipe Lines", by A. H. Gibson.

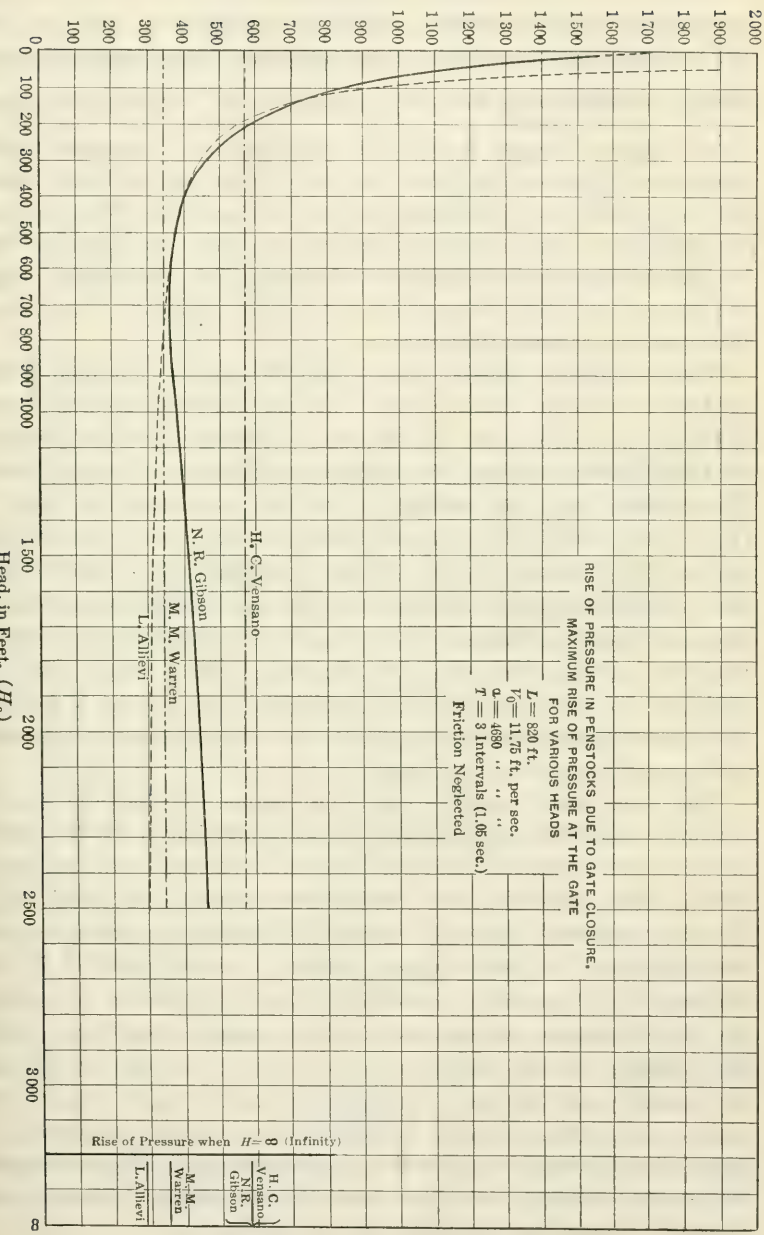
Rise of Pressure, in Feet.
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE.
MAXIMUM RISE OF PRESSURE AT THE GATE
FOR VARIOUS HEADS
L = 820 ft.
V0 = 11.75 ft. per sec.
a = 4080 " " "
T = 3 Intervals (1.06 sec.)
Friction Neglected
H. C. Vensano
N. R. Gibson
M. M. Warren
L. Allievi
Rise of Pressure when H = ∞ (Infinity)
H. C. Vensano / N. R. Gibson
M. M. Warren
L. Allievi
0 100 200 300 400 500 600 700 800 900 1000 1500 2000 2500 3000 ∞
Head, in Feet. (H0)

FIG. 4.

of curves for various heads has been plotted from the result obtained by using the writer's formulas, and these are shown in full lines. It will be noted that these curves show maximum water-hammer for any duration of closure from zero up to one interval $\left(\frac{2\,L}{a}\right)$, and, as the duration of closure becomes longer, the resulting rise of pressure finally approaches, within certain limits, the value shown by the Allievi curve. For low heads and short durations of closure, the Allievi curves generally show higher values of pressure rise than the writer's; but, for high heads and short durations of closure, they show lower values of pressure rise. This interesting fact will be referred to later when discussing the pressure-time curves.

The formulas of Messrs. Warren and Vensano do not include the net head as a factor, and, therefore, each may be represented, as shown in Fig. 3, by a single curve for all heads. Although these two formulas are objectionable, because they neglect the influence of the net head, it is evident, from the position of the curves representing them in Fig. 3, that under certain special conditions they will give, at least approximately, correct results. These conditions will be referred to later when discussing the pressure-time curves, but it is interesting to note here that Mr. Warren's formula gives approximately the correct results when the net head is such that the excess pressure will be a minimum for any given duration of closure. Mr. Vensano's formula gives approximately the correct result when the net head is very high with respect to the velocity destroyed.

Fig. 4 has been drawn to show the manner in which the rise of pressure varies with the net head. The results shown by the curves in Fig. 3 are plotted for a given duration of closure, ordinates representing excess pressure, but abscissas representing net head ($H_0$). It is thus seen that, for a given duration of closure, the excess pressure becomes less as the head increases, until at a certain value of $H_0$ the minimum rise of pressure is reached, and, as $H_0$ continues to increase, the rise of pressure also increases until it reaches a final value, when $H_0$ is infinite. In the example shown in Fig. 4, $L$ is only 820 ft., and this length would represent the limit of gravity head. The curves, however, have been extended for higher heads, on the assumption, of course, that the head is produced by applied pressure. The corresponding curves obtained from the results of the Allievi, Warren, and Vensano formulas are also clearly shown in Fig. 4.

## Pressure-Time Curves.

The pressure-time curves, Figs. 5, 6, and 7, show clearly the changes in pressure that take place during the closure of the gates under various typical conditions. The corresponding curves obtained from the

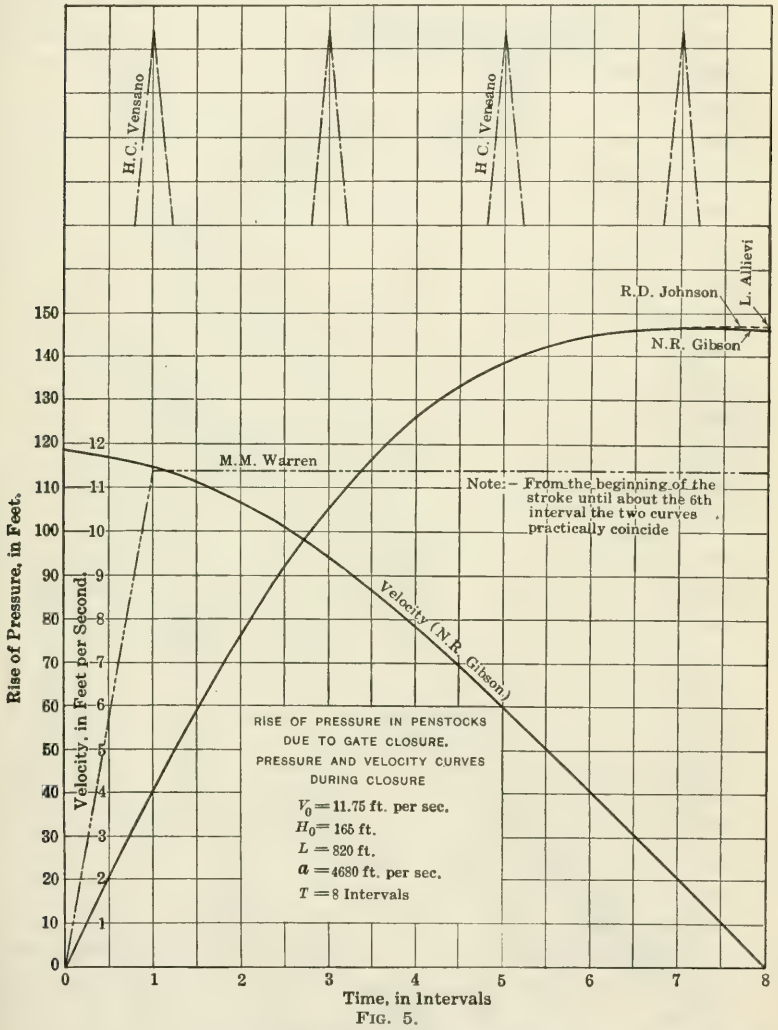
H.C. Vensano
H.C. Vensano
L. Allievi
R.D. Johnson
N.R. Gibson
M.M. Warren
Note:– From the beginning of the stroke until about the 6th interval the two curves practically coincide
Velocity (N.R. Gibson)
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE. PRESSURE AND VELOCITY CURVES DURING CLOSURE
$V_0$ = 11.75 ft. per sec.
$H_0$ = 165 ft.
$L$ = 820 ft.
$a$ = 4680 ft. per sec.
$T$ = 8 Intervals
Rise of Pressure, in Feet.
Velocity, in Feet per Second.
Time, in Intervals
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
0 1 2 3 4 5 6 7 8
0 1 2 3 4 5 6 7 8 9 10 11 12

FIG. 5.

formulas of Allievi, Warren, and Vensano have been shown in these figures for the purpose of comparison with those of the writer, and in order that the various results may be studied and explained. In some

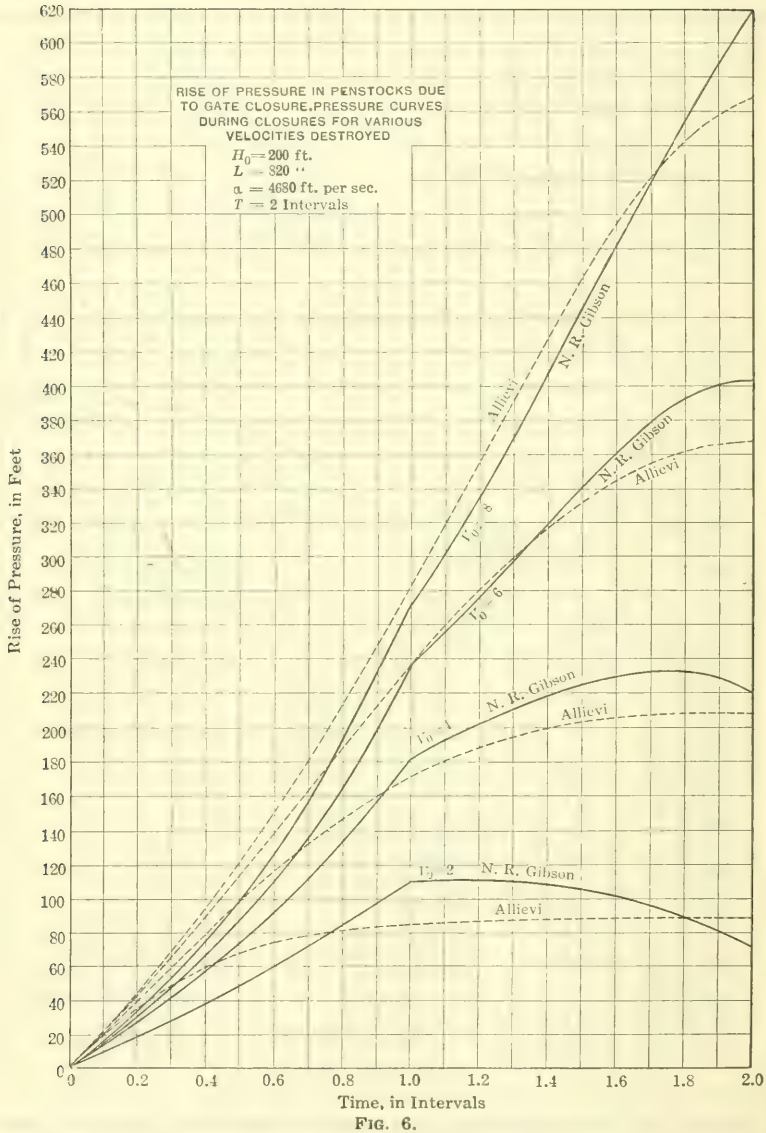
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE, PRESSURE CURVES DURING CLOSURES FOR VARIOUS VELOCITIES DESTROYED
$H_0$ = 200 ft.
$L$ = 820 "
a = 4680 ft. per sec.
$T$ = 2 Intervals
Rise of Pressure, in Feet
Time, in Intervals
$V_0$ = 8
$V_0$ = 6
$V_0$ = 4
$V_0$ = 2
N. R. Gibson
Allievi
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

FIG. 6.

cases velocity-time curves have also been drawn, in order to show the variable rate of retardation caused by uniform gate closure.

It will be noted first that Mr. R. D. Johnson's pressure-time curve, based on Allievi's formula, or indeed Allievi's formula itself, gives the maximum pressure rise always at the end of the closing time. Mr. Warren's curve shows the excess pressure rising uniformly to a maximum at the end of the first interval and then remaining constant until

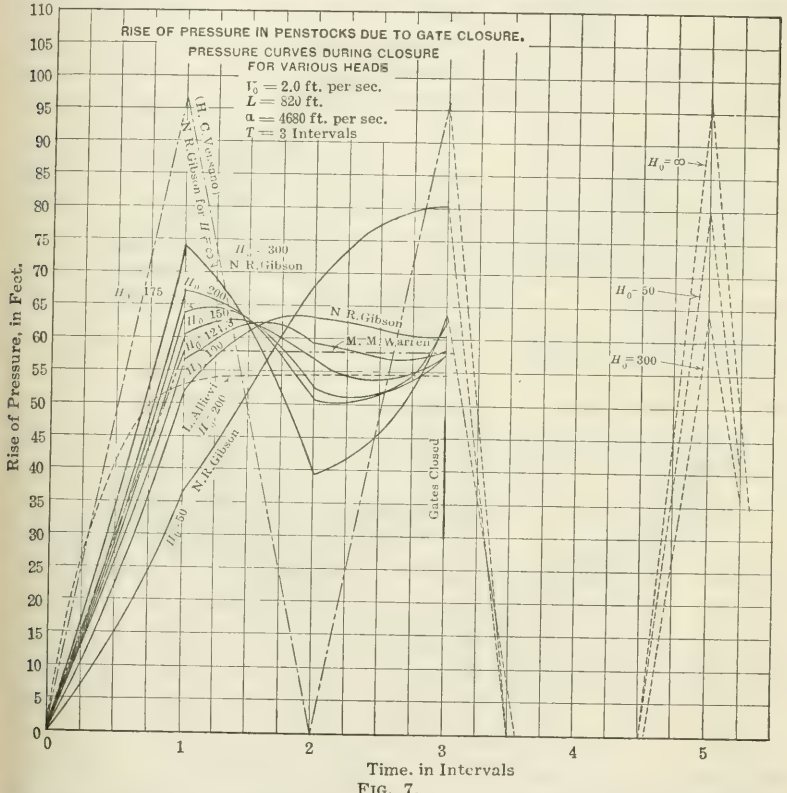


FIG. 7.

the end of the closing time. Mr. Vensano's curve shows the excess pressure rising uniformly to a maximum at the end of the first interval, falling uniformly to zero at the end of the second interval, and repeating this vibration until the end of the closing time. The writer's pressure-time curves may be similar to any one of these three, depending on the duration of closure and the net head acting on the orifice, or on both of these factors.

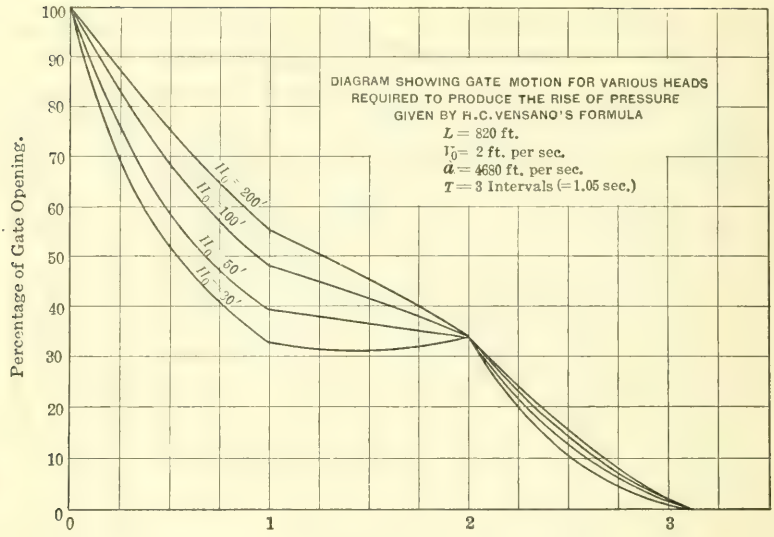
DIAGRAM SHOWING GATE MOTION FOR VARIOUS HEADS
REQUIRED TO PRODUCE THE RISE OF PRESSURE
GIVEN BY H.C.VENSANO'S FORMULA
L = 820 ft.
V0 = 2 ft. per sec.
a = 4680 ft. per sec.
T = 3 Intervals (= 1.05 sec.)
H0 = 200'
H0 = 100'
H0 = 50'
H0 = 30'
Percentage of Gate Opening.
Time, in Intervals
0
10
20
30
40
50
60
70
80
90
100
1
2
3

FIG. 8.

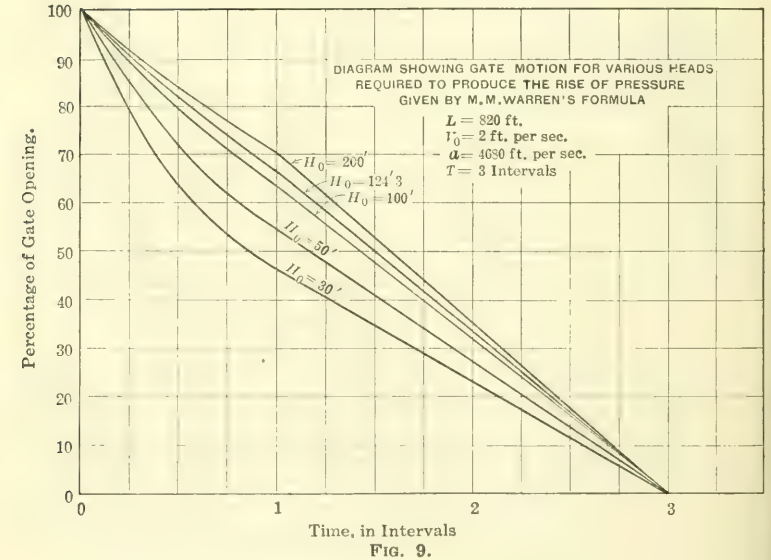
DIAGRAM SHOWING GATE MOTION FOR VARIOUS HEADS
REQUIRED TO PRODUCE THE RISE OF PRESSURE
GIVEN BY M.M.WARREN'S FORMULA
L = 820 ft.
V0 = 2 ft. per sec.
a = 4680 ft. per sec.
T = 3 Intervals
H0 = 200'
H0 = 124'3
H0 = 100'
H0 = 50'
H0 = 30'
Percentage of Gate Opening.
Time, in Intervals
0
10
20
30
40
50
60
70
80
90
100
1
2
3

FIG. 9.

Commencing with Fig. 5, it is seen that the pressure-time curve, under the conditions stated, is almost identical with that given by Mr. R. D. Johnson, as far as can be detected by the eye. A careful consideration of the writer's formula, however, will reveal the fact that the pressure-time curve obtained from it is not continuous, but is made up of a series of curves, each being one interval long, and cusps or changes of curvature occur at the end of each interval. Under other conditions, the cusps are plainly visible, as, for example, in Figs. 6 and 7. For any finite conditions, these cusps, theoretically, do not disappear, that is to say, the tangent at the end of one interval never exactly equals the tangent at the beginning of the next interval. Furthermore, the slope at the beginning of the writer's curve is never exactly the same as the slope of the Johnson curve. For all practical purposes, however, the pressure-time curves shown in Fig. 5 (and numerous other curves for similar conditions) are almost identical, and the maximum pressure rise occurs in both of them at the end of the stroke. This is interesting because the two theories from which the respective formulas are derived are totally different. When the conditions are such as to produce practically identical pressure-time curves similar to the foregoing, it indicates that the effect of the compressibility of water, the elasticity of the pipe walls, and the resulting harmonic vibrations in the water column may be neglected, and in such cases the assumptions, on which the Allievi formula has been based, are practically sufficient.

The results obtained from the Warren and Vensano curves are much at variance with the foregoing, as indicated in Fig. 5, and the writer is of the opinion that neither of these formulas can apply for all values of $H_0$, and, only under certain conditions, which will be mentioned later, are they approximately correct.

As shown in Fig. 3, the maximum pressure rise given by the writer's formulas, as would be expected, is nearly always less than that given by the Allievi formula when the duration of closure is short and when $\frac{H_0}{V}$, the ratio of head to velocity destroyed, is small. When the ratio of head to velocity destroyed is large, the reverse is the case, and, when $H_0$ becomes infinitely large, the writer's formulas agree with that of Mr. Vensano and give results twice as great as Allievi's formula for any finite duration of closure greater than one interval. Even

when the values of maximum pressure-rise, as given by the Allievi formula, are in close agreement with those of the writer, both for short and long durations of closure, the respective shapes of the pressure-time curves may be different. Figs. 6 and 7 show clearly the characteristics of the pressure-time curves in a number of typical cases, and a close study of them, together with Fig. 4, will make clear the relation that exists between the rise of pressure and the net head for any velocity destroyed. The shapes of the pressure waves that continue after the gates have been closed, until damped out by friction, are also indicated in Figs. 1 and 7.

Referring now to Fig. 7, it will be noted that the particular case when Mr. Warren's formula gives approximately correct results is when the head is such that the rise of pressure due to gate closure is a minimum for the particular velocity destroyed. This occurs when $H = \frac{3}{7}\frac{aV}{g}$.

Fig. 7 shows, also, the shapes of the pressure-time curves for various heads, and indicates the variation in time when the maximum pressure occurs during closure.

The foregoing examples, except Tables 2 and 5, have all been calculated for uniform gate motion. As the writer's formulas may be applied for any variable rate of gate motion, it is interesting to determine the nature of the gate motion for various heads that would be required to produce diagrams similar to those proposed by Messrs. Warren and Vensano. A diagram of the shape proposed by Mr. Warren may be produced by the simple expedient of increasing the speed of gate travel at the end of the first interval to double the rate of its motion during the first interval and maintaining this double rate until the end of the stroke. Such an operation, though giving the same shape to the pressure-time diagram, will not, of course, give the same rise of pressure as for the same duration of uniform closure, but the latter is given by a gate motion similar to that shown in Fig. 9. If a pressure-time diagram of the same shape as Mr. Vensano's is desired for a low head, a very complicated gate motion would be required, such, for example, as that shown in Fig. 8. In a similar manner, the gate motion required to produce any suggested form of pressure-time curve may be determined.

The manner in which excess pressures vary from gate to origin has been explained in Miss Simin's translation of Professor Joukovsky's paper, although therein worked out on the erroneous assumption of uniform retardation of the velocity of the water flowing in the pipe.

O. V. Kruse, Assoc. M. Am. Soc. C. E., who was associated with the writer at the time this paper was first written, has made an original study of the variation in excess pressure from gate to origin, based on the writer's application of Joukovsky's theory to slow-closing gates. The results of this study, which will appear as a discussion, together with other comments from him, prove that when the duration of uniform closure is less than $\frac{2\,L}{a}$ the maximum pressure is exerted along the pipe to a point where the distance to the origin is equal to $\frac{T\,a}{2}$. From that point to the origin the pressure reduces uniformly to zero. When the duration of uniform closure is equal to, or greater than, $\frac{2\,L}{a}$, the maximum rise of pressure occurs at the gate, and from there to the forebay or origin reduces to zero, uniformly along the length of the pipe.

## Fall in Pressure.

Professor Joukovsky's theory of pressure waves applies also to the fall in pressure produced by opening a valve or gate at the end of a pipe line, and the application of his theory to the case when a valve is gradually opened may be made in a similar manner to the foregoing. It is obvious, of course, that the fall in pressure caused by opening a valve in a certain time is not precisely the same as the rise in pressure caused by closing the valve in the same time, because the rate of acceleration cannot be the same as the rate of retardation. It would lengthen this paper unduly, however, to do more than state here that the formulas for fall in pressure may be obtained in a similar manner to those given herein, the principles being the same in both cases.

## Experimental Results.

The writer has not yet had an opportunity of testing the formulas presented in this paper by experiments, to show, not only the correctness of the values of maximum pressure rise, but also the shapes of the pressure-time curves under various conditions. It is expected, however,

that an opportunity of doing so may possibly occur in the not too distant future. In the meantime this paper is presented in the hope that it will receive criticism or confirmation from those interested in the subject.

The experimental results obtained by Mr. Vensano, and presented in his paper entitled "Pulsations in Pipe Lines", give some striking confirmation of the correctness of the writer's formulas, not only as regards the maximum pressure rise, but also as indicating the resemblance between the calculated and observed pressure-time curves, both before and after the gate was completely closed, and at various points along the pipe line, as well as at the gate.* These, however, were carried out under a very high head (1 260 ft.), and could hardly be accepted as a general proof.

The writer also proposes to show how the pressure-time diagram may be used to determine the velocity of flow in a pipe, for the purpose of measuring the rate of discharge previous to the closing of the gate. This will be made the subject of another paper to be written at a future time.

In conclusion, the writer desires to accord credit to Mr. O. V. Kruse for the valuable help he has given in the preparation of this paper, to Mr. R. L. Hearn for the work of preparing Figs. 8 and 9, and to Mr. R. D. Johnson for the many helpful suggestions he has kindly made.

* See discussion by Norman R. Gibson in *Transactions*, Am. Soc. C. E., Vol LXXXII, p. 236.

# MEMOIRS OF DECEASED MEMBERS

NOTE.—Memoirs will be reproduced in the volumes of *Transactions*. Any information which will amplify the records as here printed, or correct any errors, should be forwarded to the Secretary prior to the final publication.

## ROLLA CLINTON CARPENTER, M. Am. Soc. C. E.*

DIED JANUARY 19TH, 1919.

Rolla Clinton Carpenter was born near Orion, Mich., on June 26th, 1852. His father, Charles K. Carpenter, owned an extensive farm at that place, and was the Vice-President of a railroad connecting Detroit and Bay City, which now forms a part of the Michigan Central System.

Rolla Clinton Carpenter's early education was received in the district school and in the Pontiac High School, from which he entered the Michigan Agricultural College, receiving the degree of Bachelor of Science in 1873. In 1875, he received the degree of Civil Engineer from the University of Michigan, and then returned to the Michigan Agricultural College, as an Instructor and Graduate Student, receiving the degree of Master of Science in 1876. In 1878 he was elected Professor of Mathematics and Civil Engineering at the same institution, and served in this position until 1890.

As his vacations occurred during the winter, Professor Carpenter spent a part of the time in study at other engineering colleges. At the Massachusetts Institute of Technology he studied under Professors Peabody and Lanza. His graduate study was completed at Cornell University, which conferred on him the degree of Master of Mechanical Engineering in 1888. His relation as Consulting Engineer to the Lansing Iron and Engine Company, of Lansing, Mich., placed at his disposal the facilities of a large and up-to-date manufacturing plant, which afforded opportunities for investigation exceeding those of any technical school. He was thus greatly assisted in the preparation of his thesis on the subject of "Internal Friction in Non-Condensing Engines." The late Robert H. Thurston, M. Am. Soc. C. E., then Dean of Sibley College, read a paper on this thesis before the American Society of Mechanical Engineers, and, in his discussion, showed that Professor Carpenter's investigations played an important part in changing ideas then prevalent about steam engine friction.

In 1890, Professor Carpenter was called to Cornell University by his election as Associate Professor of Mechanical Engineering in Sibley College. The mechanical laboratory work was then organized as a separate department under his direction, and, during the next five years, the equipment of the laboratories was rapidly enlarged. Professor Carpenter's intimate relation with various industrial enterprises

* Memoir prepared by Henry S. Jacoby, Assoc. Am. Soc. C. E.

peculiarly fitted him for the development of a course of instruction in Experimental Engineering. His success in this respect had a pronounced influence on similar courses in other engineering colleges, and on the methods of teaching other sciences. In 1895 he was promoted to a full professorship, and his title was changed to that of Professor of Experimental Engineering. This position he held until the time of his retirement from active service, in June, 1917.

Professor Carpenter's "Notes on Mechanical Laboratory Practice" was published in 1891. This work formed the basis of his later book on "Experimental Engineering", which has been the leading manual on the subject in the United States. The first edition of his book on heating and ventilation, entitled "Heating and Ventilating Buildings", was published in 1895. This book has had six revisions and an extensive circulation. It contains much original material from the author's own experience, and is quoted largely by later writers on the subject. He was a joint author with Professor Diederichs of a text-book on "Gas Engines." He also made numerous contributions to engineering periodicals and to the transactions of various societies, notably the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Society of Heating and Ventilating Engineers. He was a frequent contributor to *The Sibley Journal,* of which college periodical he was an Associate Editor during the entire period of his official relation to Cornell University.

He was engaged in a diversified field of investigation and research, which included problems relating to power plants, gas engines, cement manufacture, coke manufacture, railway management, heating and ventilating, etc. He was one of the greatest patent experts in the country, and was employed by many of the leading law firms in various parts of the United States. He invented a number of pieces of laboratory apparatus, such as the Carpenter coal calorimeter, which was for many years a standard for testing the heating value of coal; the throttling and separating steam calorimeters, extensively used at present; a friction testing machine, which may be found in most of the large laboratories; and an inertia governor for the steam engine.

Professor Carpenter had been honored by appointment to various positions of distinction and trust. He was a judge of machinery and transportation at the Columbian Exposition at Chicago in 1893, at the Pan-American Exposition at Buffalo in 1901, and at the Jamestown Exposition in 1907. He was a member of the commission appointed by the Academy of Science in 1915, at the request of the President of the United States, to investigate the slides at the Panama Canal and to make such recommendations as in the judgment of the commission would improve the conditions and lessen the possibilities of slides in the future. In 1907, the Michigan Agricultural College conferred on him the degree of Doctor of Laws.

He was a member of eight of the leading engineering societies of America; during 1908-11, he was Vice-President of the American Society of Mechanical Engineers, and had served on various committees, the most important service perhaps being rendered on the Boiler Code Committee. He was President of the American Society of Heating and Ventilating Engineers in 1898, Vice-President of the American Society of Automobile Engineers in 1910-12, and he had taken an active interest in the student branch of the American Society of Mechanical Engineers at Cornell. He was a member of Tau Beta Pi, and Sigma Xi, being President of the Alpha Chapter of the latter society in 1912-13. His relation to social and fraternal societies included membership in the Engineers' Club of New York City, the New York Railroad Club, the Town and Gown Club of Ithaca, Delta Tau Delta, and the Masonic fraternity.

Professor Carpenter's kindly manner and genial disposition made it easy for even the most timid to approach him, and he was never too busy to be considerate of any one who sought his counsel and advice. His enthusiasm in original investigation, and his capacity for hard work inspired his students to a similar attitude and effort. Outside the university his counsel was widely sought by the Government, in large engineering undertakings, and in patent legislation. His colleagues in the faculty appreciated his good judgment and his extensive knowledge of the engineering profession and of human nature. He was a pleasant companion and a loyal friend. Thus, his influence has been far-reaching both in engineering education and practice.

At the beginning of November, 1918, Professor Carpenter fell and fractured his leg, and this confined him to his home. Before this, he had made his contribution to war work by devoting himself untiringly to the development of the Liberty motor. This obliged him to travel extensively, and that is believed to have aggravated a spinal ailment due to a fall about three years before. He died on January 19th, 1919.

He was married to Miss Marion Dewey, at Greenville, Mich., on May 25th, 1876. His wife, two sons, and a daughter survive him.

Professor Carpenter was elected a Member of the American Society of Civil Engineers on April 4th, 1911.

## WILLIAM WILLIAMS CREHORE, M. Am. Soc. C. E.*

Died September 13th, 1918.

William Williams Crehore, the son of John T. Crehore and Lucy Williams Crehore, of Cleveland, Ohio, was born in that city on February 3d, 1864.

Those who knew Mr. Crehore intimately held him in high esteem for his great ability in his profession and for the loftiness of his ideals

* Memoir prepared by Gustav Lindenthal, M. Am. Soc. C. E.

and purity of character. In this he resembled his father, a distinguished civil engineer and a mathematician of high rank, who died on October 7th, 1884.

Mr. Crehore was graduated from Yale University in 1886, having been obliged to lose a year owing to a railroad accident resulting in a broken leg. After 1886, he tutored for a year; he was then given the Larned Scholarship, and returned to Sheffield (Yale) Scientific School for the post-graduate course in Engineering. He took his degree of Civil Engineer in 1888. During the same year he was married to Anna, the eldest daughter of the late Frank W. Ballard, of New York City. He was then for two years Principal of the Hemenway High School, in Norfolk, Va.

In 1889 Mr. Crehore acted as Bridge Inspector for the Pennsylvania Railroad, at Lewistown, Pa., where the Johnstown Flood had made necessary the rebuilding of several bridges. In 1890 he entered the service of Cofrode and Saylor, Bridge Builders, in Pottstown, Pa.; later, he worked for the Baltimore and Ohio Railroad and for the Wallis Iron Works, of Jersey City, N. J., before he opened an office as an independent Civil Engineer in 1892 in New York City.

At just about that time there came into vogue the system of steel frame construction for tall buildings, and Mr. Crehore was one of the first to develop structural designing in that branch of engineering. His resourcefulness and skill as an engineer was shown by the fact that he was called on as a consultant for many large buildings in New York City, in the West, in Cuba, and in the South. The cantilever foundations of the tall American Tract Society Building in New York City were originated and designed by him especially to suit that difficult foundation case. He also developed special designs for foundations under buildings to prevent the menace from quicksand to surrounding structures.

Mr. Crehore, as a public spirited citizen, took a great interest in the advocacy and discussions of the subways in New York City, acting as an advisor to the Merchants Association of New York and also in the public controversies which arose as to the economy and safety of some of the bridges across the East River. He also gave his time and services generously to public welfare in his home town, Metuchen, N. J., where he lived before going to California. He was a most intense and enthusiastic worker in anything to which he put his hand, and those who dealt with him had complete confidence in his judgment and thoroughness.

He had a profound love of truth and a loathing for all false assumption. He hated sham, humbug, and charlatanism with all the energy of his soul, and these traits made for him a host of staunch friends.

Mr. Crehore's many-sided nature is shown by the fact that he was an assiduous student of economics and had written a scholarly work,

"Protection's Brood", dealing with the problems and economic evils arising from the protective tariff, and particularly pointing out the corruption bred by the excesses of that system. The book gives evidence, not only of painstaking research and analysis, but also, in its easy fluent style, of high literary ability. His discussion is a model of fairness, clarity, and comprehensiveness, and his emphatic language and unsparing criticism of certain evil conditions that had resulted from ruthless competition contributed not a little to their correction, and earned for him a high reputation among thinkers and students of economics. Mr. Crehore properly considered national economics a legitimate field for the study and activity of the Engineer, whose professional interest should be centered through them in the development of public utilities and great public works.

During his college days, Mr. Crehore had obtained a fine musical education from New York's best teachers, and he was passionately fond of classical music. With his fine baritone voice he was a valuable member of the University Glee Club of New York from its organization, in the early Nineties, and sang regularly with it until he left—a sick man—for the West in 1915.

Mr. Crehore was very devoted to his family. He left a widow and nine children—four sons and five daughters. Three of his sons distinguished themselves during the war in France, in the military service of the United States. One son, Sergeant Austen B. Crehore, volunteered in the French Lafayette Flying Corps, and received for his valor the Croix de Guerre with palm.

Mr. Crehore's long illness prepared his friends for his death, and this he faced with cheerful resignation. With members of his family around him, he passed through days of happiness, in spite of his fatal affliction. He died at Los Angeles, Cal., on September 13th, 1918.

His many lovable qualities, his rectitude, and his fine character will not be forgotten by those who had the privilege of knowing him intimately, and they, with his family, cherish his memory as that of a noble and manly nature.

Mr. Crehore was elected an Associate Member of the American Society of Civil Engineers on April 4th, 1894, and a Member on September 3d, 1902.

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## ALEXANDER JOSEPH NORRIS, M. Am. Soc. C. E.*

DIED MAY 30TH, 1918.

Alexander Joseph Norris was born on November 4th, 1864, at Vera Cruz, Mexico, where his father, Henry De Butts Norris, one of the early associates of William R. Grace in railway construction in South

* Memoir prepared by the Secretary from information on file at the Headquarters of the Society.

America, was engaged in building a railroad. The boy studied under private tutors, but was sent to the United States to complete his education, and was graduated from Rensselaer Polytechnic Institute in June, 1886, with the degree of Civil Engineer.

Mr. Norris began his engineering career as Draftsman for the Phœnix Bridge Company, at Phœnixville, Pa., and was engaged in that capacity and also on special bridge inspection for M. S. Carter and Company, of St. Louis, Mo., and for the Missouri Pacific Railroad Company, from November, 1886, to September, 1887.

From September, 1887, to March, 1889, he was employed by the City of New York as Inspector on street paving, and, after April, 1888, was in charge of all paving for the city north of 59th Street and east of Fifth Avenue. He then went to the Connecticut River Granite Company, of Lyme, Conn., as Superintendent, which position he held until June, 1890, when he was appointed Assistant Engineer on his father's staff with the Peruvian Corporation, Limited, of London, and made reconnaissances and preliminary surveys and estimates for railways in Peru and Bolivia, as well as examinations and reports for the reconstruction and equipment of practically all the railroads in Peru.

In 1891, Mr. Norris was appointed first as Engineer on the location of a 50-mile extension of the Southern Railway (Ferrocarril del Sud) and afterward as Chief Engineer of Construction, designing all bridges, culverts, stations, etc.

From July, 1893, to November, 1894, he was employed as Assistant Engineer with the City of New Orleans, on drainage work for that city. While in this position illness in the family compelled Mr. Norris to resign and take charge of his father's business affairs, in which he continued until June, 1896. He then engaged in private practice as a member of the firm of Pratt and Norris, of Essex, Conn., quarry operators and general contractors for the construction of breakwaters, buildings, and all classes of stone work.

In November, 1897, Mr. Norris was appointed Assistant Engineer on the Nicaragua Canal Commission with which he remained until March, 1901, serving for 10 months in Nicaragua as Transitman and Chief of Party, and the remainder of the time in Washington, D. C., on estimates, drafting plans, etc.

In March, 1901, Mr. Norris again engaged in the private practice of engineering as senior member of the firm of A. J. Norris and Company, Contractors, which firm built part of the electric railway between Amsterdam and Schenectady, N. Y. In November, 1901, he organized the firm of Norris and Penguet, and was engaged on contract work for the Chesapeake and Ohio Railroad on the Big Sandy River in Kentucky, as well as for the Deepwater Railroad in West Virginia.

In March, 1906, Mr. Norris went to Peru as Chief Engineer of the Ferrocarril Central del Peru, and remained in that country until his

death on May 30th, 1918. During this time he served as Engineer in charge of a 60-mile extension of the Central Railway of Peru; Engineer in charge of the Chilete Extension of the Pacasmayso and Guadalupe Railway; and as Chief Engineer in charge of all construction and maintenance for the Peruvian Corporation, Limited, of London, which position he held at the time of his death.

The greatest railway construction project with which Mr. Norris was connected, and in which his engineering skill was shown, was the successful construction of the railroads, reaching an altitude of practically 16 000 ft., over the Peruvian Andes, and their subsequent maintenance and improvement, which work brought him international fame.

Mr. Norris was married in November, 1893, to Frederika H., the only child of Capt. Henry C. Henshaw, U. S. A., Retired, who, with two sons and a daughter, survives him.

In recognition of his work in Peru, Mr. Norris was the recipient of many honors, among which were medals awarded by various scientific societies and by the Government of Peru. He was frequently sent as a representative, both by the Peruvian Government and the Peruvian Corporation, Limited, on important missions to Europe and the United States, and was widely known in the Latin-American countries, where the news of his death was received with sincere regret and sorrow by his many friends.

Mr. Norris was elected a Member of the American Society of Civil Engineers on October 3d, 1911.

## MYRON HALL PECK, M. Am. Soc. C. E.*

DIED OCTOBER 9TH, 1918.

Myron Hall Peck was born at Racine, Wis., on October 13th, 1876. He was the son of Dr. Albert P. and Celia Flagg Peck. His father served in the Civil War, although he was only 17 at the time of his enlistment. In 1880, the family moved to Shantung Province, China, where Dr. Peck was a medical missionary under the American Board of Commissioners for Foreign Missions—the Congregational organization—for more than 20 years, and Myron Hall Peck's boyhood was spent in China and in California. He was graduated from the College of Civil Engineering at the University of California with the Class of 1897, with the degree of B. S.

After graduation, he engaged in civil engineering and mining work in various parts of California until 1902, when he returned to China to become Professor of Civil Engineering in the Chinese Imperial University in Shansi and, later, at the Imperial Pei Yang University at

* Memoir prepared by A. T. Parsons, Assoc. M. Am. Soc. C. E.

Tientsin, which position he held until he came back to the United States in 1911.

Mr. Peck's first work after his return was for the War Department, on the improvement of the bar at the mouth of the Columbia River. Following this, he went to San Francisco, where he opened engineering offices, which he maintained most of the time until 1916. During part of this time, he was engaged as Engineer in Charge of the improvement of the channel at Mare Island Navy Yard, for the Standard American Dredging Company, the contractors doing the work.

In 1916, he enlisted in Company A of the Engineer Corps of the California National Guard, and served as Second Lieutenant during the Mexican Border troubles, being stationed most of the time at Nogales, Ariz. By special arrangement, he was mustered out of the service in December, 1916, at the request of the Citizens' Committee of Vallejo, Cal., in order that he might prepare a report on channel conditions and other factors which might influence the possible enlargement of the Mare Island Navy Yard, the Committee recognizing that his experience in connection with the improvement of the channel made him particularly fitted for this work. Later, he went to Washington on behalf of the Committee.

Soon after the Engineer Officers' Reserve Corps was created, Mr. Peck applied for a commission, and was assigned for training to Camp Lee, Va., early in 1917. He was commissioned a Captain and spent several months in training troops at Camp Lee. In January, 1918, he sailed for France. Then followed a brief period of further work back of the lines, but the last few months of his life were mainly spent at the front with the Second Division, commanded by Major-General John A. Lejeune. Captain Peck was at Chateau Thierry, St. Mihiel, and in many less-known engagements. During a large part of the time he acted as Battalion Commander, his untimely death doubtless preventing his promotion to the rank of Major.

On October 9th, just after he had led his battalion through a particularly brilliant action near St. Etienne-a-Armes, which won for him the posthumous honor of the Distinguished Service Cross, Captain Peck was struck by a fragment of shell and killed instantly.

No better idea of the stuff of which Captain Peck was made, as well as the circumstances of his death, can be given than by quoting from the following letters, the first being from the First Sergeant of his Company:

"At 8 A. M., October 9th, we were being attacked and the 'boche' put over a murderous barrage. Captain Peck was standing in the cemetery, which we occupied and regarded as our strong point, directing his men. He seemed oblivious to all danger and fell in the performance of his duty. * * *

"This regiment has suffered a severe loss, as the late Captain was a model soldier and gentleman in every respect. As my company commander, I had been on several reconnaissance and other details with him, and I learned to admire his soldierly ability and gentlemanly qualities. In fact, I felt perfectly safe in following Captain Peck anywhere, and I lost a close friend when death called him away.

"JOHN D. DRURY,
"First Sergeant, Company E, Second Engineers."

The second extract is from a letter from the Colonel of his Regiment:

"Captain Peck was killed in action during particularly difficult fighting. His death came directly as a result of his fearless exposure of himself in doing his duty. He was beloved by his men for his personality, his qualities of leadership, and his apparent fearlessness.

"His body was immediately recovered by his comrades, and as carefully buried as was possible under existing circumstances. Later, it was removed to a French cemetery. * * * The headstone was carved by one of his men, who did all the carving with a pocket-knife. It was a labor of love. * * *

"His efficiency was becoming increasingly evident, and he would soon have been made a Major. In fact, he had been actually commanding the battalion for two months.

"W. A. MITCHELL,
"Colonel, Second Engineers."

Although these letters do justice to the gallant soldier who has gone from us, they do not give a complete idea of the capable engineer and the true friend it was a privilege to know.

Captain Peck was a charter member of the Engineers' Club of San Francisco, having served as Vice-President during the year following its founding in 1912.

In 1905, Captain Peck was married to Miss Mary Moore, who, with two children, Gladys Logan and Albert Carlton Peck, survives him. He is also survived by his parents, Dr. and Mrs. A. P. Peck, of Tientsin, China, by two brothers, Willys R. Peck, U. S. Consul at Tsing-Tao, China, and Llewellyn B. Peck, of San Francisco, Cal., Second Lieutenant in the Aviation Section, Signal Reserve Corps, U. S. Army, and one sister, Mrs. Thomas T. Read, of Montclair, N. J.

Captain Peck was elected an Associate Member of the American Society of Civil Engineers on January 5th, 1909, and a Member on March 14th, 1916.

## STANLEY DEAN, Assoc. M. Am. Soc. C. E.*

DIED OCTOBER 2D, 1918.

Stanley Dean, the son of John Dean and Elizabeth Stevenson Findlaw Dean, was born in Manchester, England, on February 22d, 1879.

* Memoir prepared by Alfred E. Phillips, M. Am. Soc. C. E.

At the age of nine he came to the United States with his parents, his father being engaged in engineering contracting at that time. His education was obtained in various schools, mostly in the South and West, as his father's business necessitated moving from place to place.

In 1901 he entered Washington University, St. Louis, Mo., where he remained two years. The family then settling in Chicago, Ill., Stanley entered the Civil Engineering Department of the Armour Institute of Technology, from which he was graduated in 1905 and received the degree of Civil Engineer in 1910.

The following record of Mr. Dean's professional experience is taken from his application for a commission in the Quartermaster Corps, U. S. Army:

1900-05, Timekeeper, Material Clerk, Carpenter, and Concrete Foreman, successively, during all of 1900 and to September, 1901; during the summers of 1902-03-04, on construction of concrete arches, culverts, abutments, piers, and earthwork incidental to double tracking the Grand Trunk Western Railway. In 1905, Superintendent of Construction, for John Dean and Company, of Sixth Avenue Arch Bridge, Des Moines, Iowa. In December of the same year superintended the construction of abutments and culvert at Muir, Mich., for the Grand Trunk Western Railway. In 1906, in the employ of Hugh L. Cooper, M. Am. Soc. C. E., as Draftsman and Designer on parts of McCall Ferry and Keokuk water-power developments, made surveys and gaugings of Trent River, at Healeys Falls, Ontario, and was Transitman on topographical surveys for water-power developments at Schaghticoke and Johnsonville, N. Y.; in charge of reconnaisance work for water power on Connecticut River and East Canada Lakes, New York, and Engineer in Charge of location, surveys, and borings for foundations, etc., at Schaghticoke, N. Y. In 1907, Engineer in Charge of preliminary surveys and investigations, Ingham Mills water-power development, East Canada Creek, New York, and made a similar survey and investigation on Broad River near Columbia, S. C.; April, 1907, engaged on coffer-dam and stone cribwork investigation for proposed 125-ft. concrete dam foundations, East Creek, New York; May, 1907, engaged on Broad River surveys, South Carolina; June-August, 1907, East Creek investigations; September-December, 1907, Resident Engineer in charge of field engineering work, assisting Superintendent of Construction in development of water power at Schaghticoke, N. Y., 20 000 h. p., 150-ft. head. This work involved building an ogee gravity dam averaging 25 ft. high, 700 ft. long, in solid concrete, together with intakes, canal, ½ mile long, 120 000 cu. yd. of earth and rock excavation, 12-ft. riveted steel pipe line, 800 ft. long, steel surge-tank, penstocks, and power-house, 56 by 110 ft., for four units, the cost of the work being $1 250 000. In 1908 was engaged on above described work. January-April, 1909, in a similar position, finishing

water-power development at Johnsonville, N. Y., 4 000 h. p.; May-August, 1909, Superintendent of Construction on water-power development, Fountain Falls, Montreal River, Ontario, until abandonment of work due to consolidation of companies; then Engineer on construction of Ragged Chutes transmission lines, and spiral riveted pipe carrying compressed air to Cobalt Mining camp; made report on Matabitchouan River development. All the foregoing water-power work was done in the employ of Viele, Blackwell, and Buck, of New York City.

In 1910, Mr. Dean was appointed Instructor in Civil Engineering at the Armour Institute of Technology, having charge of instruction in hydraulics, water power, reinforced concrete, and general construction methods and costs. In 1912 he was made Assistant Professor of Civil Engineering, and, in 1917, Associate Professor of Hydraulic Engineering.

During the summer of 1912 Professor Dean was engaged as Resident Engineer for Solomon, Norcross, and Keis, at Watervliet, N. Y., on the construction of a 100-ft. earth dam for the storm-sewer system. During the summer of 1913 he was associated with the writer in the design and supervision of construction of a hollow concrete dam on a sand foundation, at Hamlin Lake, Michigan.

From June to October, 1917, Professor Dean was Principal Assistant to the Supervising Engineer, Department of Constructing Quartermaster, at Camp Jackson, Columbia, S. C., in charge of all surveys and layout work for topography, roads, railroad track and yards, buildings, sewers, water supply, etc.; and, from July to October, he was in charge of the engineering design and supervision of construction of water lines, reservoir of reinforced concrete having a capacity of 1 250 000 gal., pumping station, 30 miles of sewers, septic tank, and other incidental structures. Professor Dean returned to the Armour Institute of Technology in October, 1917, remaining until January, 1918, when he resigned to become Principal Assistant to the Supervising Engineer, Department of Constructing Quartermaster, Camp A. A. Humphreys, Accotink, Va., in charge of railroad location, general surveys, and dock construction.

He received a Captain's commission on August 24th, 1918, and was then Supervising Engineer in the Constructing Quartermaster Corps at Camp Humphreys, Va. He was supervising the building of a dam and power plant at Springfield, Va., in connection with Camp Humphreys, when, on October 2d, 1918, he was instantly killed at a railroad crossing.

He was in an automobile on his way to the dam at Springfield. A colored chauffeur was with him, but Capt. Dean was driving at the time. The crossing at this place is very dangerous, the view of the tracks being obstructed. He had waited for a train to pass and then

started across the tracks only to be caught by a fast train from the opposite direction. The chauffeur jumped and escaped without injury, but Capt. Dean, in trying to save himself and the car, stalled the engine and then jumped to save himself. He was struck and thrown 100 ft., and instantly killed.

As a student, instructor, engineer, and a man among men, Stanley Dean was one in a thousand. Absolutely honest, upright, clean mentally and morally, he commanded the love and respect of all with whom he came in contact. He possessed a keen, analytical mind, infinite patience, and ability of concentration that was reflected in whatever he undertook. He loved to teach, and his professional experience, combined with up-to-date knowledge of his specialty, made him an ideal instructor.

He was married on December 14th, 1913, to Miss Ellen Hallaway, of Schaghticoke, N. Y., who, with a daughter, survives him.

Capt. Dean was elected an Associate Member of the American Society of Civil Engineers on April 1st, 1908.

## WILLIAM WETMORE GIBBS, Assoc. M. Am. Soc. C. E.*

DIED JANUARY 13TH, 1919.

William Wetmore Gibbs was born in Melbourne, Fla., on January 12th, 1889. From his earliest years he had a marked taste for constructive work and applied science, and this led him to take up the study of Civil Engineering, in spite of a great many difficulties. He entered the University of Florida in 1905, worked his way through by his own energy and industry, and was graduated in 1909 with the degree of B. S. C. E., having been the first graduate in Civil Engineering from that University. His record as a student was one of brilliant achievement in his studies, combined with prominent activity and leadership in student enterprises. After his graduation he always retained a hearty interest in the University of Florida, frequently visiting it and keeping up his acquaintance among its faculty and alumni.

Immediately after his graduation Mr. Gibbs was placed in charge of a part of the work of planning and laying out the suburb of Jacksonville known as Ortega. A few months later he entered the employment of The Phosphate Mining Company, at Nicholas, in Polk County, Florida, where, on account of his splendid ability, and notwithstanding his youth, he was rapidly advanced through various positions until he became Assistant General Manager of the company and second in charge of this large enterprise.

* Memoir prepared by Dr. J. R. Benton, Secretary, Florida Engineering Society.

Immediately on the entry of this country into war, he gave up his position, went to Washington for training, volunteered for service in France, was commissioned First Lieutenant, and sent overseas, being attached to the 6th Engineers, Company B. After several months' service, his health broke down and he was invalided home for recuperation. Much to his distress, he was unable again to satisfy the medical officers of his physical fitness for further active service, and, after a few months, he was given an honorable discharge from the Army. Pending his discharge, Lieut. Gibbs threw himself actively into the educational campaigns for Liberty Bonds and Red Cross funds, and, fresh from his experiences in France, was able to speak with very great effectiveness in these campaigns. Immediately on his discharge from the Army, he opened an office as Consulting Engineer at Gainesville, Fla., and quickly developed a successful practice. While engaged on some of his professional work near Green Cove Springs, early in January, 1919, he contracted influenza, from which he died scarcely more than a week later in Jacksonville.

On November 2d, 1910, Mr. Gibbs was married to Miss Lucia Patton, who, with three children, survives him.

He was not only a man of great native ability and high promise in his profession, but also possessed unusually fine personal qualities. He had to an extraordinary degree the faculty of winning both the good will and the confidence of all with whom he came in contact. It was his temperament to follow with a great deal of enthusiasm whatever he undertook; and this spirit was characteristic of his attitude to his chosen profession, in which he took both pride and pleasure, and for the higher ideals of which he displayed the greatest devotion.

Mr. Gibbs was a charter member of the Florida Engineering Society. In 1916 the University of Florida granted him the degree of C. E. He was a member of the Alpha Tau Omega fraternity and of the Phi Kappa Phi honorary fraternity.

Mr. Gibbs was elected a Junior of the American Society of Civil Engineers on October 7th, 1914, and an Associate Member on May 15th, 1917.

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## NORMAN MARSHALL HALCOMBE, Assoc. M. Am. Soc. C. E.*

Died February 15th, 1919.

Norman Marshall Halcombe, the son of the late Arthur Follett Halcombe, of Fern Grove, Urenui, Taranaki, New Zealand, was born at The Pines, Feilding, New Zealand, on July 29th, 1878.

He attended the public schools in New Zealand, and in August, 1905, he entered Stanford University as a special student. He was

* Memoir prepared by E. W. Sawyer, Assoc. M. Am. Soc. C. E.

graduated, with the degree of B. A. in Civil Engineering, in 1909. While at Stanford University he was engaged in numerous activities, was President of the Stanford Society of Civil Engineers, a prominent member of the Eucina Club, and took part in several dramatic productions.

Mr. Halcombe served as an Apprentice in the Machine Works of David Murray and Company, at Wanganui, New Zealand, from March, 1899, to October, 1900, and then, until November, 1901, as a Machinist (Improver) at the Machine Works of Joseph Sparrow and Son, at Dunedin, New Zealand, on the construction and erection of gold dredges. He served as Foreman and then as Draftsman with Goniuan and Company, Engineers, of Newcastle, New South Wales, from March, 1902, until March, 1905, on colliery plant and machinery. His next work was with the Schäake Machine Works, of New Westminster, B. C., Canada, as a Draftsman on the design of cannery and saw-mill machinery.

He was employed as Draftsman for the Bay Cities Water Company from February, 1906, until July, 1907, on computations, etc., for the Sierra Water Supply for San Francisco, and was then engaged, until August, 1908, as Field Draftsman on the survey of the Yuba and Feather Rivers, and as Instrumentman and in charge of level party for the California Débris Commission. From the latter date until November, 1908, Mr. Halcombe was Chief Draftsman for the Stone Canyon Coal Company, and was engaged in designing head-works, tracks, trestles, bridges, buildings, tipple structure, dam, etc. Then, until September, 1909, he was Contractor's Engineer for the Atlantic, Gulf, and Pacific Company, of San Francisco, in charge of dredging Oakland Harbor, dredging for wharf foundations for Government docks at Fort Mason, San Francisco, and the construction of three bulkhead structures in Oakland Harbor. From September, 1909, until May, 1910, he was Junior Engineer with the City of San Francisco, on the construction of a section of the overflow conduit. He then became Engineer of the Carmen Creek Mining Company, of Salmon, Idaho, and was engaged in the erection of an experimental gold mill.

Mr. Halcombe served for five years as Chief Engineer with Messrs. Duryea, Haehl, and Gilman, on large irrigation projects, surveys, compilations of data, computations, design, construction, etc. He was then engaged in private practice in San Francisco for two years.

His action with regard to the war was very praiseworthy, as he gave up a lucrative practice in San Francisco, and traveled to London at his own expense to offer his services in assisting to defeat the Germans. He joined the Royal Engineers early in 1915, and was commissioned as Second Lieutenant on May 1st of that year. He was promoted to Lieutenant a month later, and gained his Captaincy on August 4th, 1915. He commanded and trained the 31st Cheshire Field

Company, R. E., from June 1st to August 20th, 1915, and was then ordered to Gallipoli as Captain with the 21st Welsh Field Company, R. E. At Gallipoli he was transferred and placed in command of the 21st Cheshire Field Company, R. E., and, later, was sent to Egypt on special evacuation work, followed by special transport work in the Western Desert, Egypt and Sinai, for which he was mentioned in dispatches.

Capt. Halcombe joined the Royal Flying Corps on November 1st, 1916, and organized and developed the Engine Repair Depots, in Egypt and Palestine. He did some special work and reported on technical subjects in connection with the Air Service. He received his commission as Major on November 16th, 1917, and was twice mentioned in dispatches.

Maj. Halcombe returned to England on September 1st, 1918, in connection with the liaison work of the Royal Flying Corps then being carried out in the United States. Arriving in London at a time when technical men were scarce, his contemplated trip to America was forestalled, and he was attached for immediate service to the Technical Department, Parachute Section, of Aircraft Production.

At the time the Armistice was signed he was still in this position, as Major in the Royal Engineers and the Royal Air Force. He expected to return to San Francisco to re-open his business there in connection with the firm of Halcombe, Flanders, and Read, but was offered an important staff position on the Indian Establishment of the Air Force in India, and made arrangements to sail for India, on January 23d, 1919. On the day before he sailed, he was married at St. Mary's, Battersea, to Miss Blanche Stuart, eldest daughter of Wesley and Amy Turton, of "Hawkshead", Lake Wakatipu, New Zealand. Mrs. Halcombe followed her husband on the next boat. He was attacked with influenza and pneumonia on the voyage, and at Port Said was removed from the steamer to the Red Cross Hospital in a very weak condition from which he did not recover, but passed away on February 15th, 1919.

Maj. Halcombe is survived by Mrs. Halcombe, who has returned to her home in New Zealand; a brother, A. H. Halcombe; and two sisters, Mrs. M. A. Taylor and Mrs. M. L. Gordon Glassford.

"Joe", as he was familiarly called by his associates, was a great favorite, especially among his engineering friends. He had a quick wit and a thorough appreciation of a joke. He had a high conception of the duties of an engineer, and as he was absolutely thorough in everything he did, his judgment in engineering as well as in personal matters was relied on by all who were in close touch with him. His sacrifice in the war is a monument to his conscientiousness, and the example he has set will not soon be forgotten. He will be sincerely missed by his many friends and by all who were privileged to know him.

He was a valuable member of the Press Club, of San Francisco, and, on leaving in 1915 to join the English forces, his fellow-members made him an Honorary Member.

Maj. Halcombe was a member of the Western Society of Engineers, and of several clubs in London. He was elected a Junior of the American Society of Civil Engineers on September 3d, 1907, and an Associate Member on May 2d, 1911.

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## VICTOR HUGO BELL, Jun. Am. Soc. C. E.*

DIED JANUARY 6TH, 1919.

Victor Hugo Bell was born at Hutchinson, Kans., on July 6th, 1891. When he was only a few years old, his mother moved to San Diego, Cal., where the boy received his early schooling. He began his engineering studies at the University of Washington, and, in 1912, entered Valparaiso University at Valparaiso, Ind., from which he was graduated with the degree of B. C. E. in June, 1914, receiving his C. E. degree in August of the same year. At college, Mr. Bell had the reputation of being an honest, energetic, and apt student.

Prior to entering college, he was employed from March to November, 1910, as Stakeman, Chainman, and Leveler with the Chicago, Milwaukee and Puget Sound Railway Company; and from December, 1911 to March, 1912, and from March to June, 1912, as Transitman with L. B. Harris, Consulting Engineer, of San Diego, Cal., and the Western Salt Company, of Otay, Cal., respectively.

Immediately after his graduation in 1914, Mr. Bell returned to California and opened an office in Calexico for the private practice of engineering. His work there was chiefly in connection with the irrigation of the Imperial Valley, such as erecting timber headgates and bulkheads for the South Alamo Water Company, irrigation, land grading, and the subdivision of 169 acres into city lots, for the Royal Lands Company, as well as assisting the City Engineer of Calexico and working on numerous other engineering and surveying jobs.

When the United States entered the war, Mr. Bell closed his office in Calexico and enlisted in the Army. He entered the Science and Research Division and was graduated as a Second Lieutenant from the United States Army School in Texas. He was then assigned to the Science and Research Division of the Army Balloon School at Arcadia, Cal., where he was stationed at the time of his death. He was killed on January 6th, 1919, in an automobile accident on the highway between Pasadena and Los Angeles, and was buried with full military honors

* Memoir prepared by the Secretary from information on file at the Headquarters of the Society.

at Fort Rosecrans, Cal. He is survived by his mother, Mrs. Mary F. Bell.

Lieut. Bell was a Member of the Western Society of Engineers and was prominent as a Knight of Columbus. He was elected a Junior of the American Society of Civil Engineers on March 14th, 1916.

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## CHARLES GILBERT REILLY, Jun. Am. Soc. C. E.*

DIED SEPTEMBER 29TH, 1918.

Charles Gilbert Reilly, the son of the late John C. Reilly and Ursula O'Connor Reilly, was born at Pittsburgh, Pa., on December 12th, 1889. After his preliminary schooling, Mr. Reilly entered Princeton University, from which he was graduated in June, 1912, with the degree of Civil Engineer.

After his graduation, Mr. Reilly traveled in Europe for several months, and, on his return to Pittsburgh, entered the employ of the Pittsburgh Railways Company, on double-track work from Pittsburgh to Castle Shannon, on the Castle Shannon Division. He was also engaged, for a short time, as Engineer with the Philadelphia Company, of Pittsburgh.

In 1915, he was appointed Superintendent of Construction on the plant of the Pittsburgh Model Engine Company, of which company he was also a Director and Assistant to the President.

In May, 1917, one month after war was declared, Mr. Reilly entered the First Officers' Training Camp at Fort Niagara, N. Y., and was commissioned a First Lieutenant. In August, 1917, he was assigned to Company D of the 313th Infantry, then stationed at Camp Meade, Md., where he remained until he sailed for France with the Seventy-ninth Division in July, 1918. Lieut. Reilly had been in France only one month when he was promoted to be Captain of his company.

With the Seventy-ninth Division, his company saw hard service on the fighting line in France, and Capt. Reilly was killed in action on September 29th, 1918, during the drive in the Argonne Forest.

Capt. Reilly was of an amiable and happy disposition, with a smile for every one, and had made for himself many friends. During his college days, he was Assistant Manager and Manager of the baseball team at Princeton and a member of the Tiger Inn Club. He was also a member of the Pittsburgh Athletic Association and the Oakmont Country Club.

Capt. Reilly was elected a Junior of the American Society of Civil Engineers on May 7th, 1913.

* Memoir prepared by the Secretary from information on file at the Headquarters of the Society.

## JAY WILLIAM TOMS, Jun. Am. Soc. C. E.*

DIED DECEMBER 20TH, 1918.

Jay William Toms was born at Frederick, Md., on September 16th, 1888. He prepared for college at the Frederick High School, entering Cornell University in 1905 and receiving the degree of C. E. in 1909. In college he was a member of Phi Kappa Sigma Fraternity, Semaphore, an honorary Civil Engineering Society, and the Maryland Club. He was President of the Cornell Association of Civil Engineers in his Senior year.

Following his graduation, Mr. Toms was, until 1916, a designer of reinforced concrete work for the Corrugated Bar Company, first in St. Louis, Mo., then in turn in its Buffalo, New York City, New Orleans, and Chicago offices, except for about a year, when he was employed as Estimator in the Atlanta Office of the Industrial Engineering Company.

In 1916, he formed a partnership with John Benedict, of Davenport, Iowa, for the sale of building materials, under the firm name of The John Benedict Company. In the fall of 1917, Mr. Toms' health failed, due to overwork, resulting in a severe case of pneumonia from which he never entirely recovered. In the spring of 1918 he went to Denver, hoping to improve his condition, but was recalled in October by the death of his brother, Keefer, from influenza. Having been appointed Executor of his brother's estate, he postponed his return to Denver, against the advice of his physician. The eastern climate was too severe for him, and, after contracting influenza, he lived only five days.

Mr. Toms' lovable disposition had endeared him to a host of friends, who will be shocked to learn of his untimely death. He is survived by one brother, Captain Raymond E. Toms, of the Field Artillery, U. S. A.

Mr. Toms was elected a Junior of the American Society of Civil Engineers on November 30th, 1909.

* Memoir prepared by A. P. Haney, Assoc. M. Am. Soc. C. E.

## PAPERS IN THIS NUMBER

"PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES." NORMAN R. GIBSON.

## PAPERS AND DISCUSSIONS CURRENT IN PROCEEDINGS


"Cement Joints for Cast-Iron Water Mains." CLARK H. SHAW.....Mar., 1917
Discussion.....May, Aug., "

Progress Report of the Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, etc.....Aug., "
Discussion.....Nov., "

Final Report of the Special Committee on Steel Columns and Struts.....Dec., "
Discussion.....Feb., Mar., Apr., Aug., Oct., 1918

Progress Report of the Special Committee on the Regulation of Water Rights.Dec., 1917
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"Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings." FLOYD A. NAGLER.....Jan., "
Discussion.....Mar., May, Aug., Nov., "

"Determination of the Duty of Water by Analytical Experiment." W. C. HAMMATT.....Feb., "
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"The National Railroad Question of To-Day." FRANCIS LEE STUART.....Feb., 1919
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"On a New Principle in the Theory of Structures." GEORGE F. SWAIN.....Mar., "

"The East Canyon Creek Dam." A. F. PARKER. (To be presented May 7th, 1919).....Mar., "

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# PROCEEDINGS

OF THE

# AMERICAN SOCIETY

OF

# CIVIL ENGINEERS

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(INSTITUTED 1852)

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TO CODIFY PRESENT PRACTICE ON THE BEARING VALUE OF SOILS FOR FOUNDATIONS, ETC.: Robert A. Cummings, Edwin Duryea, E. G. Haines, Allen Hazen, James C. Meem, Walter J. Douglas.

ON THE REGULATION OF WATER RIGHTS: F. H. Newell, W. C. Hoad, John H. Lewis.

TO REPORT ON STRESSES IN RAILROAD TRACK: A. N. Talbot, A. S. Baldwin, G. H. Bremner, John Brunner, W. J. Burton, Charles S. Churchill, W. C. Cushing, Robert W. Hunt, George W. Kittredge, Paul M. LaBach, C. G. E. Larsson, G. J. Ray, Albert F. Reichmann, H. R. Safford, F. E. Turneaure, J. E. Willoughby.

The Reading Room of the Society is open from 9 A. M. to 10 P. M. every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day; during July and August, it is closed at 6 P. M.

HEADQUARTERS OF THE SOCIETY—33 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE NUMBER.....4600 Vanderbilt.
CABLE ADDRESS.....“Ceas, New York.”

Vol. XLV. MAY, 1919. No. 5.

# AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852.

# PROCEEDINGS

This Society is not responsible for any statement made or opinion expressed in its publications.

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## MINUTES OF MEETINGS OF THE SOCIETY

**April 16th, 1919.**—The meeting was called to order at 8.30 P. M.; Vice-President Nelson P. Lewis in the chair; Stephen L. Coles, Assistant Secretary, acting as Secretary; and present, also, 136 members and guests.

The evening was devoted to a discussion of American Highways. W. G. B. Thompson, Assoc. M. Am. Soc. C. E., State Highway Engineer of New Jersey, addressed the meeting on "Development of New Jersey's Highway System and Its Relation to Hudson River Vehicular Tunnels and Ferries." H. Eltinge Breed, M. Am. Soc. C. E., First Deputy Commissioner of Highways, State of New York, then spoke on "The

Engineering Alliance –Some Future Developments in Engineering as Seen from a Highway Standpoint." A series of moving picture films illustrating several new devices for highway construction were shown by Mr. R. E. Brooks.

The subject was discussed by Messrs. E. W. Stern, W. G. B. Thompson, E. T. Thurston, H. E. Breed, Calvin Tomkins, N. P. Lewis, T. K. Boorman, and Clifford Richardson.

The Assistant Secretary announced the election of the following candidates on April 14th, 1919:

As Members

Percival Clow, New York City
Walter Mandeville Dawley, New York City
Edward Warren Delano, Baltimore, Md.
Martin Ryerson Everett, Newark, N. J.
John James Harman, Kewanee, Ill.
James Pinney Leaf, Rochester, Pa.
Fred Bailey Oren, Mattoon, Ill.
Arthur Irving Perry, Brooklyn, N. Y.
Charles Richard Sumner, Los Angeles, Cal.
Edward Lawrence Wagner, New York City
William Henry Wetzler, New York City
James Crew Wonders, Omaha, Nebr.

As Associate Members.

Rudolf William Beuttenmuller, Philadelphia, Pa.
Eugene Baker Brown, San Luis Obispo, Cal.
Jesse Fred Brown, Washington, D. C.
Wolstan Elliot Browne, Philadelphia, Pa.
Ernest Arden Bruce, Charleston, W. Va.
Verni Jay Chapman, Kansas City, Mo.
Hale Austin Clark, Baltimore, Md.
Perley Eugene Conner, Winnetka, Ill.
Walter Dunlap Craig, Baltimore, Md.
Norman Douglas Dean, Am. Exp. Forces
Allan Vaughn Elston, Tulsa, Okla.
Alfred Philip Fisher, San Francisco, Cal.
Leroy Ernest Gardner, Brooklyn, N. Y.
Harry Lucas Havens, Kansas City, Mo.
Ralph Emerson Herman, Jr., Fort Myer, Va.
Oscar Henry Koch, Dallas, Tex.
John Francis Laboon, Pittsburgh, Pa.
John Latenser, Jr., Wilmington, N. C.
Rex Barnum Lockwood, Manila, Philippine Islands
Frank Angus McNally, Chicago, Ill.

Arthur Garland Moulton, New York City
Thomas Flint Nichols, Phœnix, Ariz.
Walter Christian Pauli, Chicago, Ill.
Fred Peiser, New York City
John Gansovertte Rose, Denver, Colo.
Edwin Lyle Scruggs, Charlotte, N. C.
Frank Thomas Sheets, Springfield, Ill.
Christian Ludewig Siebert, Camp Dix, N. J.
Benjamin Joseph Sigmund, Philadelphia, Pa.
George Philip Alexander Stape, Dayton, Ohio
Albert Lester Stevenson, Philadelphia, Pa.
James Hargraves Tebbets, South Bethlehem, Pa.
Howard William Webb, Newark, N. J.
Carl Leslie Weil, New York City
Frederick Clifford Whitney, New Orleans, La.
James Theodore Whitney, Camp A. A. Humphreys, Va.
Harry Anthony Wiersema, Portsmouth, Va.
Chester Owen Wisler, Albany, N. Y.
Paul Henry Woodworth, Philadelphia, Pa.
Judson Zimmer, Gloversville, N. Y.

As Juniors

Warner Cotton Brockway, Camp Meade, Md.
Martin Warren Cowles, Camp Sheridan, Ala.
Samuel Jack Glaser, New York City
Edgar Young Grupe, Jr., Fort Omaha, Nebr.
John Henry Guest, Pine Bluff, Ark.
George W. McClelland, Penn's Grove, N. J.
Elwood Aitken O'Donnell, Pelham, N. Y.
Sydney Rogow, New York City
Nathaniel Leonard Shaffer, Philadelphia, Pa.
Edward Francis Weiskopf, Am. Exp. Forces
John Wesley White, Baltimore, Md.

The Assistant Secretary announced the transfer of the following candidates on April 14th, 1919:

From Associate Member to Member

Augustine Haines Ayers, Fort Shaw, Mont.
Astolfo Bartoccini, New York City
Albert Frederick Chittenden, Am. Exp. Forces
Wilbur Sherman Corkran, Camp A. A. Humphreys, Va.
George Dana Emerson, Brookline, Mass.
Joseph Hamilton Fleming, Columbus, Ohio.
Charles Goodman, New York City

Horace Sinclair Hunt, Detroit, Mich.
William Ambrose Kinsey, Newark, N. J.
John Lansdale, Am. Exp. Forces
Hallett Edward McClintock, Omaha, Nebr.
Robert Roy McGregor, Santa Barbara, Cal.
Manley Peroe Northam, New Kensington, Pa.
Leo Thomas Peden, Houston, Tex.
Charles Frederick Puff, Jr., Philadelphia, Pa.
William Le Roy Reynolds, Nitro, W. Va.
Ernest Franklyn Robinson, Camp A. A. Humphreys, Va.
James Hampden Small, Jr., Richmond, Va.
John William Swaren, Camp A. A. Humphreys, Va.
Royal Sylvester Webster, Havana, Cuba

From Junior to Associate Member

Harold Law Blakeslee, New Haven, Conn.
William Richard Cobb, Cape May, N. J.
Jacob Leslie Crane, Jr., Harrisburg, Pa.
William Edward Fitzgerald, New Brunswick, N. J.
James Kidwell Grannis, Dayton, Ohio
Charles Royce Hauke, Chinook, Mont.
Nathan Bernd Jacobs, Pittsburgh, Pa.
Emory Wilson Lane, Lafayette, Ind.
Samuel Brooks Morris, Pasadena, Cal.
Francis Tingley, Altoona, Pa.
Francis Montgomery Veatch, Lawrence, Kans.

The Assistant Secretary announced the following deaths:

Owen Brainard, of New York City, elected Member, October 3d, 1906; died April 2d, 1919.

Lewis Abel Nichols, of Chicago, Ill., elected Member, October 5th, 1892; died March 5th, 1919.

Rufus Mason Whittet, of Boston, Mass., elected Associate Member, May 2d, 1911; Member, November 4th, 1914; died December 10th, 1918.

Charles Edwin Bright, of Chattanooga, Tenn., elected Associate Member, December 3d, 1902; died April 3d, 1919.

Paul Robert Kirstein, of Cincinnati, Ohio, elected Associate Member, May 15th, 1917; died October 17th, 1918.

Angus Robert Mackay, of Wickenburg, Ariz., elected Associate Member, October 29th, 1912; died June 30th, 1918.

Walter Scott Obermeyer, of Pittsburgh, Pa., elected Junior, April 7th, 1915; Associate Member, April 17th, 1917; date of death unknown.

Adjourned.

**May 7th, 1919.**—The meeting was called to order at 8.30 P. M.; Vice-President Nelson P. Lewis in the chair; T. J. McMinn, M. Am. Soc. C. E., acting as Secretary; and present, also, 90 members and guests.

The minutes of the meetings of March 19th and April 2d, 1919, were approved as printed in *Proceedings* for April, 1919.

A paper by A. F. Parker, M. Am. Soc. C. E., entitled, "The East Canyon Creek Dam", was presented by Walter C. Parmley, M. Am. Soc. C. E., and illustrated with lantern slides.

A discussion by Edward Godfrey, M. Am. Soc. C. E., was presented by the Acting Secretary, and a brief reply thereto was made by Mr. Parmley.

The Acting Secretary announced the following deaths:

Tien Yow Jeme, of Hankow, China, elected Member, November 30th, 1909; died April 24th, 1919.

Norman Benjamin Kellogg, of San Diego, Cal., elected Junior, February 6th, 1878; Member, July 3d, 1895; died November, 1918.

Paul Jones Bean, of Troy, N. Y., elected Junior, May 2d, 1911; Associate Member, December 31st, 1913; died January 25th, 1919.

Thomas Hatcher Matson, of El Paso, Tex., elected Associate Member, October 1st, 1913; date of death unknown.

Adjourned.

## OF THE BOARD OF DIRECTION

(Abstract)

**April 14th, 1919.**—The Board met at 10 A. M.; President Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Beahan, Clark, Crocker, Davis, Elwell, Flinn, Fort, Grunsky, Herschel, A. M. Hunt, Ketchum, Langthorn, Lewis, Metcalf, Pegram, Rights, Talbot, Tuttle, Wagner, and Wall.

Mr. Rights, Chairman of the Publication Committee, presented a report, and a letter-ballot of the membership was ordered to determine whether the List of Members in the Year Book should be printed hereafter as a single alphabetical list.

It was also voted that if the membership decided on this form that the names of Honorary Members shall appear in a separate list as well as in the alphabetical list.

It was also ordered that this letter-ballot shall ask the wishes of the membership in regard to the publication in the monthly *Proceedings* of "Changes of Address."

It was voted that the letter-ballot be accompanied by an explanatory statement prepared by the Secretary, with the advice and consent of the Publication Committee.

The Board approved the action of the Executive Committee which instructed the Secretary to write to the Chairman of the Development Committee expressing the hope that a Progress Report of that Committee would be forthcoming in time to be printed and circulated to the membership before the Annual Convention, in order that it might be discussed intelligently, and to say, further, that it is necessary that such Report should be in the Secretary's hands at least thirty days prior to the Annual Convention in order that this may be properly done.

The election, by letter-ballot of the Board canvassed February 5th, 1919, of Stephen L. Coles as Assistant Secretary for one year ending with the Annual Meeting, 1920, and the retirement of Thomas J. McMinn, Assistant Secretary, was reported.

The appointment of A. S. Baldwin, M. Am. Soc. C. E., by the Executive Committee to represent the Society at a conference called by the National Service Committee of Engineering Council to be held at Chicago, April 23d-25th, 1919, to consider the establishment of a National Department of Public Works, was reported.

The Secretary also presented a Prospectus, forwarded by M. O. Leighton, Chairman of the National Service Committee, in which he states: "In the interest of efficiency of procedure at that meeting it is earnestly requested that your organization take action on the several matters presented therein, and forward to this office at the earliest possible date one of the copies of the prospectus, duly engrossed."

After discussion, the Board adopted the following:

"The Board of Direction of the American Society of Civil Engineers, approves the general principle that the engineering activities of the Federal Government should be co-ordinated and concentrated, so far as practicable, under a single responsible head, and further approves the action of the National Service Committee of Engineering Council, by its Chairman, in calling together representatives of the various engineering organizations of the country for the discussion and study of the subject and the formulation of a definite plan of action in the premises. The Board of Direction does not feel that it can give categorical answers to the queries submitted to it by the Chairman of the National Service Committee. It feels that it lacks that full and comprehensive knowledge of all the factors involved on which such answers should be based."

The Secretary reported that Messrs. J. R. Worcester and A. N. Talbot had accepted appointment as representatives of the Society on Engineering Council, and that H. J. Burt had accepted appointment as one of the representatives of the Society on American Engineering Standards Committee.

Adjourned at 12.55 P. M.

The Board reconvened at 2 P. M., and at once took up the matter of the proposed purchase of the building, 35-37 West 39th Street, brought to the attention of the Board by a letter, dated March 21st, 1919, from the Secretary of United Engineering Society, addressed to the governing bodies of the four Founder Societies, and transmitting copy of report by the Finance Committee of U. E. S. recommending that the office building, Nos. 35 and 37 West 39th Street, be purchased, and stating, further, "the project was approved by the Trustees at a meeting held March 20th, as indicated by the following resolutions, which were adopted unanimously:

*"Resolved,* That the report of the Finance Committee on the acquisition of additional real estate be and the same hereby is approved.

*"Resolved,* That the President and the Finance Committee be requested to continue negotiations for the property and to present a definite project with reference thereto; and

*"Resolved,* That the Finance Committee be requested to present a definite financial plan covering the matter;

"Both these matters to be referred to the Trustees for further action.

*"Resolved,* That while the legal counsel of United Engineering Society advise that under its Charter and By-Laws the responsibility for this purchase must rest with United Engineering Society, the Trustees, nevertheless, desire the Founder Societies to be fully informed regarding the proposed purchase, and therefore present the matter for their consideration and endorsement."

The whole matter was very carefully considered, and the following resolutions were adopted:

*"Resolved:* That it is the sense of the Board of Direction that the policy of aggregating the headquarters of Engineering Societies, other than the Founder Societies, in a common center is desirable.

*"Resolved:* That the Board of Direction of the Am. Soc. C. E. hereby directs its representatives in the Board of Trustees of the U. E. S. to oppose the proposed purchase of the office building, Nos. 35 and 37 West 39th Street, until after the project shall have been formally approved by the governing body of each of the Founder Societies.

*"Resolved:* That the Secretary be directed to send to U. E. S. and the Founder Societies and to the representatives of the Am. Soc. C. E. in the Board of Trustees of U. E. S., copies of this resolution."

Adjourned 5.30 P. M.

**April 15th, 1919.**—The Board reconvened at 9.40 A. M.; President Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Beahan, Clark, Crocker, Davis, Elwell, Fort, Grunsky, Herschel, A. M. Hunt, Ketchum, Langthorn, Lewis, Metcalf, Pegram, Rights, Talbot, Tuttle, Wagner, and Wall.

An invitation to appoint representatives on the Engineering Division of the National Research Council* was presented, and the President was authorized to appoint such representatives. President Curtis subsequently appointed Messrs. George S. Webster, H. H. Porter, and A. Marston as such representatives.

Resolutions adopted by the Kansas City Engineering Society, Ohio Engineering Society, and Rochester Engineering Society, were presented, pledging allegiance and support to the four National Societies in the development of professional engineering and the necessary legislation to procure the best results, and appealing to the Societies to act in the premises, etc., and the whole matter was referred to the Development Committee.

A budget of estimated expenses for 1919 from the Development Committee was presented, and, after discussion, and report from the Chairman of the Finance Committee, $5 000 was appropriated at this time for the use of that Committee.

The Secretary reported that the full-size model of the Alfred Noble Memorial in Rawlins Park, Washington, D. C., which was falling to pieces, had been removed.

The following resolution from Engineering Council was considered:

"*Voted:* That for the necessary support of the National Service Committee during 1919, Engineering Council ask from each Founder Society the sum of $5 000 and from the American Society for Testing Materials, an amount in like proportion to its membership. Engineering Council asks this with full knowledge of the difficulties which the grantor societies will meet in complying, but does so with the conviction that such money will be absolutely needed if the National Service Committee is to carry out the valuable work which has been started—work designed to increase respect for, and power of, the whole Engineering Profession."

In connection with this a previous communication from Engineering Council stating that no additional contribution for this purpose would be requested during 1919 was presented; also resolutions† adopted at the January 27th, 1919, meeting of the St. Louis Association of Members, favoring the voluntary contribution of one dollar per member per year for a period of three years by all members of the Society for the National Service Committee.

The following was voted:

"The Board of Direction of the American Society of Civil Engineers is unable to comply with the request from Engineering Council for an appropriation of $5 000 for the support of the National Service Committee.

"The Board of Direction of the American Society of Civil Engineers will favorably endorse action by Engineering Council if it makes

* See p. 476.

† *Proceedings,* Am. Soc. C. E., March, 1919, p. 324.

an appeal for voluntary contributions from the engineering profession at large."

Director Beahan presented certain resolutions* from the Cleveland Association in regard to the work of the Development Committee.

After much discussion the whole matter was laid on the table.

The Secretary was instructed to write to the Cleveland Association of Members as follows:

"The Board of Direction of the American Society of Civil Engineers acknowledges the receipt of the resolution of the Cleveland Local Association bearing upon the work of the Development Committee.

"The Board is greatly interested in the work of the Committee on Development and hopeful of helpful outcome from its deliberations and recommendations.

"The Board feels, however, that the action suggested by the Cleveland Association is not warranted, and for this reason tabled the resolution offered by Mr. Beahan."

It was also voted:

"That the Board of Direction expresses its great interest in the work of the Committee on Development, and trusts that it will be able to push its work through to a successful conclusion."

Past-President Talbot was requested to express to the Development Committee, through its Chairman, the sympathy of the Board with its work, the hope of the Board that that work would progress rapidly, the intention of the Board to support the Committee in its work as far as its finances will permit, and the desire of this Board that there be co-operation with similar Committees of the other societies.

The action† taken at the February 12th, 1919, meeting of the Southern California Association of Members of the Society, in regard to the importance of the work of the Development Committee, was reported, and the Secretary was instructed to advise the Southern California Association of the action which has already been taken.

The action‡ of the Duluth Association of Members of the Society recommending to Engineering Council the adoption of some plan of sending a frequent bulletin or news circular to each of the members of the four Founder Societies as a means of transmitting information, etc., was reported, and the Secretary was instructed to notify the Duluth Association that the Society will be glad to publish from time to time anything put forward of interest to the membership. Director Rights, Chairman of the Publication Committee, stated that he had attended the meeting of the Publicity Committee of Engineering Council, and that these points were brought up, and in general, that the Committee was against Engineering Council starting any form of bulletin of its

* *Proceedings*, Am. Soc. C. E., March, 1919, p. 318.

† *Proceedings*, Am. Soc. C. E., March, 1919, p. 325.

‡ *Proceedings*, Am. Soc. C. E., February, 1919, p. 209.

own, but that the Society will be glad to publish anything about which Engineering Council wanted publicity.

The President was authorized to appoint a Committee on Prizes for this year.

The resignations of 2 Members, 6 Associate Members, 1 Associate and 3 Juniors, were accepted.

Ballots for membership were canvassed resulting in the election of 12 Members, 40 Associate Members, 11 Juniors, and the transfer of 11 Juniors to the grade of Associate Member.

Twenty Associate Members were transferred to the grade of Member.

Applications were considered and other routine business transacted.

Adjourned.

The Board reconvened at 7 P. M. immediately on adjournment of the Membership Committee; President Curtis in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Clark, Crocker, Elwell, Grunsky, Langthorn, Lewis, Rights, Talbot, and Tuttle.

Messrs. L. D. Rights, Geo. H. Pegram, and J. E. Greiner were appointed a conference committee to confer with the Committee on Iron and Steel Structures of the American Railway Engineering Association and to report back to the Board.

A report from the Membership Committee was received and acted upon.

Adjourned.

# ITEMS OF INTEREST

## A Plea for Broader Technical Education—Civic Responsibilities of the Engineer*

By Mortimer E. Cooley, M. Am. Soc. C. E.†

It is most unfortunate that in the future education of our youth Latin and Greek and the other so-called dead languages are to play so little part. It is particularly unfortunate at this time when the world is planning its recovery from the war and statesmen are seeking means to prevent recurrence of wars.

Even as a preparation for engineering I have for years considered that there was no better training than Latin and Greek. Most of the big engineers of to-day went to college when Latin and Greek were prime in the curricula. They were classical students—many of them. There was comparatively little of engineering science in those days and therefore plenty of time for something else than mere technical training.

Why, then, give our youth a smattering of this and that so-called practical thing as a preparation for college? How much better it is to give them something not only preparing them for college but starting them off in life so as to be of maximum use to themselves and their fellow-men. Most young men have only four years in college; they have forty years afterward in which to learn and practise the bread and butter part of their life. The one great need to-day from our educational institutions is training for responsible citizenship.

Starting back in the grade schools, I would eliminate all fads and stress those things which make for an understanding and appreciation of natural things surrounding us. Our boys and girls should be able to see things by the roadside to which they are now blind. The hills, the fields, the forests and the streams should not be a sealed book for them. I would not teach them too much from books in the schoolroom. They can read books for themselves when they have the incentive. The incentive can be given them in the schoolroom.

Fortunate indeed is the child who has a teacher who revels in the work of teaching, who watches the child's mind develop with the same delight that a sculptor or painter sees his creation grow. Unfortunately too many of our teachers in the lower grades teach because they must make a living. They teach for the dollars and not for the love of teaching.

* Extracts from two articles by Dr. Cooley in the New York *Evening Sun*, April 14th and 15th, 1919.

† Dean of the Departments of Engineering and Architecture, University of Michigan.

Toward the end of the grades and before the high school period I would start in with Latin, giving to it the importance that it formerly had, but teach it not as a dead but a live language; and along with it take up history and the natural sciences; all in preparation for later study of these subjects. In case there is no later study—the boy and girl having to go to work—they would carry with them into life something they would otherwise never have known anything about.

In the high school I would still keep away from fads and hammer away on the fundamentals, stressing all those things which fit one to live one's life better and getting out of it enjoyment for oneself and those with whom one has to live. I would develop in them love of country rather than of self. This period could be made of vast use to the nation, and should be, as it is the finishing school of most young men and women. Such a training as I am thinking of would also be the very best training for college.

The college should follow along the same lines, stressing in the early years the things which make for general training, leaving the special things for a later period. Comparatively little specialization should, however, be done in the college. The work leading to the bachelor's degree should in the main be for general education. Following the college should come specialization in the field of one's life work.

This plan would add a year, perhaps two, but the delay would not really be any handicap. It certainly would not be so in engineering. One large employer of engineers complained that college engineers nowadays were unsatisfactory; that while they knew special engineering things extremely well, they did not know anything else; that what employers needed were young men of parts, those who could take part in activities not of a strictly technical character; that more than all else the world to-day needed engineers of imagination and vision to see beyond the walls built up around them in college.

For the young American going into engineering I would advise a thorough preparation in fundamentals, eschewing all fads, even manual training and the practical things thought so essential to his success, and including not less than two years of Latin, preferably three or four years. Considerable history, some political economy. A good knowledge of English and of literature. A speaking knowledge of at least one foreign language and if only one it should be Spanish. Some philosophy and as much of art, music and other things apparently having nothing to do with engineering as possible.

This would bring to the world a type of engineer now rarely met—one, who besides being able to do the things required of him as an engineer, would be able to do other things vastly more important, it may be, and which only one with an engineering training could do. In a word, it would give to the world generals of engineering—masters of organized effort.

* * * * * *

In the present day maelstrom of social and industrial unrest which, according to the press of America and Europe, is menacing the civilized world, many curative measures have been suggested. The most powerful agent, however, is the workingman himself. I believe that the highest type of constructive "workingman" is the professional engineer, who is the connecting link between capital and labor.

Our entire material world, so far as social structure is concerned, can be very justly credited to the engineer, or to professional men intimately allied with the engineer. Our great buildings, our transit lines, our industrial plants, our national and international communications by wire, wireless, mail, steamship, and the distribution of our wares, all owe their origin and comparative perfection to the engineer.

And yet there is one phase of the engineering profession which is little understood—even by men of the calling—which is of even broader value to the nation than that of material advancement. This is the relation of the engineer, in the different branches of his science, to the worker—the hewer of wood, the forger of iron, the carver of stone—who typifies the constructive half of our civilization known as "Labor" and his equal and important intimacy with the other, the provisioning and directing half, usually termed "Capital."

If we are to solve the tense problems which have arisen through the last few years of bloodshed, misery and spreading dissatisfaction with certain of our living conditions, no saner, surer mediator can be found between the classes than the man who proves to both "upper" and "lower" strata his sincerity, working ability and right to adequate reward—the engineer.

The engineer is to the workingman who materializes his blue-prints and obeys his personal directions the symbol of science, of intellect, of education and of that "teamwork" which is the keynote of modern achievement. In his task and his ability he is one of the most powerful rebuttals of Bolshevism and industrial unrest.

To the employer and the capitalist whose profits depend upon his accuracy and energy, the engineer is the governing factor of business success in production. His creative vision, growing from his scientific training, and brought to fruition by the virility of his practical executive ability, is the foundation of modern achievement in a thousand ways.

But there is even a greater field of achievement for the engineer, one in which his past works have given him unique power and justification. This is in the line of unselfishness, creative, scientific participation in citizenship. America's towns, cities, States and the nation itself all need more expert aid and advice in the multifold problems of Government and growth. The engineer should devote more of his abilities to the general good, and the public should more persistently seek his aid.

In short, the engineer should enter public life, giving his talents and technical skill for the good of his neighbors. Local engineering societies in the various towns and cities should co-operate with their neighbors and with municipal authorities not only in technical problems, but in social and industrial, as well, because of their unusual knowledge of and acquaintance with people of all classes. Their ability as mediators of labor problems, their scientific knowledge of the details of public matters should be given without charge for the general good.

As to State and national problems we need more engineering skill in the direction of executive matters. Lawyers seem to predominate in nearly all lines of general public life; yet, these are questions of international importance in every branch of Government work which need administration by scientifically trained minds.

The lack of engineering experts is due as much to the unwillingness of the engineer to enter political life as to the public, in not urging him to do so. Engineers do not like politics; yet politics—in government—are necessary to every phase of modern society and industry. How many engineers are there in Congress, in Cabinet positions—even in public service commissions? In labor boards and boards of trade?

A great practical asset of American life is being wasted by the loss of engineering brains and training in the everyday problems of life. This means sacrifice on the part of the big-spirited engineer who devotes more or less of his time and energy to financially unprofitable public work. But this is a big period of world history and all of us must make sacrifices, as, indeed, most of us have, that we may perfect our civilization and perpetuate our national ideals against the ominous attacks of ignorant social discontent.

Our engineers, in order to fill the great positions in national and municipal life, however, must be educated along broader and deeper lines than are current in the university courses of to-day. At the present time our technical institutions are specializing too much. Vision, background, knowledge of life and the "humanities" suffer at the expense of an almost selfish concentration on laboratory methods.

We must break down the walls which we are building around the new generation of young men in our colleges—walls so high that they cannot see over. We must so teach that the boys who are going to become engineers will not remain "privates" or "non-coms," but can be field officers and line officers of the highest ranks, qualified to command and campaign from the hilltops, looking far ahead and with historic perspective.

We should develop in America a new kind of engineer by lengthening study courses, by broadening interests and by instruction in the wider range subjects which deal with all sides of modern life. Our international leadership in industry, commerce and political idealism

demand superior training for the young men who are to continue the administration of our affairs.

With the extension of international activities ahead of us as the results of war changes we must train our young scientific men in modern languages, in history, in economics, and above all in the essentials of general culture, that they may hold their intellectual "own" in competition with the scientists of other lands.

No longer is government simply the administration of a system of statutes, the collection of taxes and duties and the maintenance of a military system.

It is a complicated machine by which the citizens themselves drive forward the great industrial, social, commercial, aesthetic and idealistic entity of the State,—in which all their varied interests are inextricably bound. Commercial or industrial problems affect those of education and artistic development; the working classes, from the humblest wage-earner to the executive of the largest corporation, are dependent for their lives, comfort and happiness upon the efficiency of the Government's many branches of direction and agency.

And so it is that the designers of our railroads, our electrical systems, our manufacturing plants and machinery, our steamships, our sanitary systems, our defensive weapons—the army, navy, signal, supply and air services—should be prepared for their broadening task with a broadening, cultural education. Our future engineers should stand head and shoulders above the present professional man of to-day to fulfill their full duties to the nation and to themselves as citizens.

### Building and Construction Outlook Promising

Contracts let in March show conclusively that building and construction works are getting under way despite the talk of high prices, says a report from the U. S. Department of Labor. With the March record—it is better than the March record in any year since 1911, excepting 1917, when Government construction made the record abnormal—in mind, the results of a study of building and construction conditions made by the Division of Public Works and Construction Developments in the United States Department of Labor takes on new significance. This study is based on 6 446 building and construction projects known to be contemplated at the signing of the armistice. The construction costs involved are $1 892 275 000, and it is a safe conclusion that 50% of these projects, involving more than half the total construction costs, are yet to be started.

With March showing a remarkable increase over January and February in contracts let, and with approximately a billion dollar's worth of projects known to be contemplated, there appears to be justification for the prediction that 1919 will prove one of the greatest in American history for building and construction work.

## Engineers', Architects', and Constructors' Conference on National Public Works

The conference called by the National Service Committee of Engineering Council to consider the proposed creation by Congress of a National Department of Public Works, and other matters, was held in Chicago, Ill., on April 23d, 24th, and 25th, 1919. Delegates from 74 technical societies and related organizations representing a membership of over 100 000, were present. The sessions were well attended, great interest was shown in the discussions, and opinion seemed to be unanimous as to the importance and advisability of the creation of a National Department of Public Works.

A. S. Baldwin, M. Am. Soc. C. E., Vice-President of the Illinois Central Railroad Company, represented the American Society of Civil Engineers by authority of the Board of Direction. The following digest of the proceedings is made from Mr. Baldwin's report:

Chairman J. Parke Channing, of Engineering Council, called the conference to order, and M. O. Leighton, M. Am. Soc. C. E., Chairman of Engineering Council's National Service Committee, was elected permanent chairman. The provisional programme prepared in advance was adopted as the programme of the conference.

Upon a report of the Resolutions Committee the following was unanimously adopted:

"This conference of the delegates from engineering and related organizations respectfully recommends to the Public and to the Congress, that legislation be enacted covering the following principles:

"1. That the services and bureaus of the National Government having to do chiefly with matters of engineering and architecture, be grouped in one department to be known as the Department of Public Works.

"2. That the Department of Public Works comprise those works which are built and operated for the use of the Public.

"3. That the Department of Public Works be made available when desirable for the performance of special engineering and architectural work for the use of other Government bureaus."

For the purpose of furthering the passage of a bill creating a National Department of Public Works, the conference, by resolution, set up an Executive Committee, a Committee on Text of Bill, and a Campaign Committee. The Executive Committee was empowered to create a Finance Committee and other committees and to add to its own membership or to that of its committees. Mr. Leighton was made Chairman of the Executive Committee of 13 members. He also is *ex officio* Chairman of the Text of Bill Committee of 10 members, and

of the Campaign Committee of 48 members representing all sections of the United States.

It was decided by resolution that the conference should be known as "Engineers', Architects' and Constructors' Conference on National Public Works."

The Committee on Government Engineering Activities made a report with recommendations differentiating from other departments the bureaus which logically should belong to a National Department of Public Works.

During the afternoon session on April 25th there was an active discussion covering the relations of Engineering Council to national, state and local societies not members of Engineering Council, the summation of which was a strong endorsement of Engineering Council.

Mr. Baldwin read to the conference, by authority of the Board of Direction of the American Society of Civil Engineers, a telegram from the San Francisco Association of Members urging the Government to appropriate one billion dollars for the construction of roads and other public works to be administered by a National Board of Public Works. This telegram was referred to the Committee on Resolutions which took no action with reference to it.

Mr. Baldwin also presented a resolution adopted by the Board of Direction of this Society on April 15th, 1919, to the effect that the Board approves the general principle that the engineering activities of the Federal Government should be co-ordinated and concentrated under one head and also the action of the National Service Committee of Engineering Council in calling the present conference. These resolutions were read in connection with the offering of credentials and entered in the minutes of the meeting.

The conference, in adjourning, offered resolutions of thanks for courtesies extended by individuals, by the technical societies of Chicago, and to the Western Society of Engineers for facilities provided for the work of the conference.

### Death of Prominent Chinese Engineer

Press dispatches announce the death on April 24th, 1919, at Hankow, China, of Tien Yow Jeme, M. Am. Soc. C. E., the Chinese engineer who constructed the Peking-Kalgan Railway, said to be the only Chinese railway built without foreign assistance. Mr. Jeme was a graduate of Sheffield Scientific School, Yale University. He was Chinese delegate on the Inter-allied Railway Commission dealing with the Trans-Siberian Railway.

## Aims of the Engineering Division, National Research Council

The Engineering Division of the National Research Council consists of representatives of the four Founder Societies, representatives of the four most important non-founder societies, and members at large. The representatives of the American Society of Civil Engineers are Messrs. George S. Webster, H. H. Porter, and Professor Anson Marston.

It is stated that the Engineering Division intends to stimulate and co-ordinate research in all branches of engineering. This, it is hoped, will be accomplished through the formation of committees, very largely outside of the Division's membership, for the study of specific problems. At the present time fourteen such committees have been organized and are more or less actively at work on particular problems.

The Engineering Division's conception of the committee idea is that the whole group should be representative of the subject under discussion. Individual members of a committee may be those who can give or procure financial assistance for the particular project, those who can act in an advisory capacity without devoting any great amount of time, and those who can devote the greater part or all of their time to research. The general principle that the beneficiaries of the research should supply the funds for carrying on the work is being followed to as great an extent as possible.

The active group within a committee very frequently is composed of the younger men in the profession requiring, of course, remuneration where they devote a considerable part or all of their time to the work. It is considered essential to have such groups within all committees in order to accomplish substantial results. In some of the committees one or more Government Bureaus may form the active group which supplies the funds and furnishes the men for carrying on a particular project. Working with them are men of large experience in the industries who can act in an advisory capacity without serious sacrifice of time. The Committee on Pyrometry may be taken as an example of this sort of co-operation. Dr. George K. Burgess, of the Bureau of Standards, a recognized authority on pyrometry, is Chairman of the Committee. There are twelve members of the Committee, comprising representatives of various manufacturers and users of pyrometers. Among these are the men who actually carry on experimental work under the general direction of the Committee.

Meetings of the Engineering Division are held in New York City approximately every two months. During the absence in Europe of Dr. Henry M. Howe, Chairman of the Engineering Division, Mr. G. H. Clevenger is Acting Chairman.

### Appointment of State Reconstruction Committees

Readjustment of relations between labor and capital, which occupies a large place in the attention of the public at the present time, is being considered by commissions in various States, according to the *Monthly Labor Review* of the U. S. Department of Labor. In the State of Wisconsin a special committee was authorized by the Legislature at a special session early in 1918 to report on "a comprehensive social and economic welfare programme of reconstruction after the war to include civilians whose status has been affected by the war, as well as soldiers." This report was presented to the Legislature in February, 1919.

In matters relating to labor it makes recommendations in regard to improving financial conditions of co-operative organizations; enactment of laws looking to fair wages and good working conditions; housing of workingmen and others, including relief of congested districts; guaranty by law of the right, both of employers and employees, to organize and bargain collectively; furnishing employment by means of road building; extension of minimum wage law; rehabilitation of victims of industrial accidents; representation of organized labor on educational boards and provision for short industrial courses; teaching English, industrial history, and Americanization to aliens; extra educational opportunity to working boys and girls and enforced schooling of illiterate minors between the ages of 18 and 21; representation of labor on boards of directors of industrial corporations; social insurance; basic eight-hour day; equal pay for women; workmen's compensation; and regulation of private colonization projects in the interests of the settler.

In California a committee has been appointed by the Governor to co-operate with Federal, State, county, and municipal officials in dealing with unemployment, especially in relation to returned soldiers. The Legislature also passed a resolution creating a joint legislative committee to investigate and report on the question of unemployment. The Governor of the State of New York has appointed a reconstruction commission of 36 men and women. Massachusetts has a legislative committee of reconstruction, and, in Michigan, an interim committee of 20 men and women has been named by the Governor to study unemployment and other problems arising in the transition period between war and peace. This committee will make recommendations, as a result of its investigations, to a reconstruction commission. A State conference was held in Augusta, Me., in January, for the purpose of consultation on issues of reconstruction.

### New Civil Engineering Instructor at Princeton

Capt. Edward A. MacMillan, who served in France with the Engineer Corps of the United States Army, has been appointed Instructor in Civil Engineering at Princeton University.

### Good Roads Legislation

The Post Office Appropriation Bill passed recently by the 65th Congress makes available to June 30th, 1921, a total of Federal and State moneys of $550 000 000 for the construction and improvement of highways in the United States, to which may be added another $10 000 000 appropriated for roads and trails in the National Forests. The expenditure of this vast sum is to be made under the direction of the Secretary of Agriculture, but the responsibility of determining plans to be approved and costs to be allowed will devolve on the Chief of the Bureau of Roads and Rural Engineering.

The funds are apportioned to the various States for the construction of highways as follows: one-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States; one-third in the ratio which the mileage of rural delivery routes and star routes in each State bears to the total mileage of such routes in all the States. Each State receiving benefits, must secure, through its highway department, the approval of the Secretary of Agriculture to the road projects that it is desired to build, and the Federal appropriation is then made available for construction according to such approved plan in an amount not exceeding 50% of the total cost. The plan is co-operative. The State must appropriate and use a sum of money equivalent to that made available from the Federal treasury.

Mr. Thomas H. MacDonald, formerly Chief Engineer of the Iowa State Highway Commission, who was recently appointed by the Secretary of Agriculture as Engineer in immediate charge of this work, with the title of Director of the Office of Public Roads and Rural Engineering, took up his new duties on May 5th, 1919. He predicts that 10 000 miles of new roads will be completed under the present plan before January 1st, 1920, and is perfecting his Washington organization on this basis. This involves co-operation with the forty-eight State Highway Departments which are already in existence. The regulations issued under the Act have been carefully revised in the light of past experience and from suggestions offered by State Highway Departments, the standards for plans, specifications, and estimates have been modified to meet special conditions existing in some of the States, and other changes in practices and procedure have been and are being made, all with the definite object of speeding up the work.

The War Department has just announced that it will turn over 20 000 motor trucks to the Secretary of Agriculture for use in the construction of Federal Aid roads, in accordance with the provision of the Rural Post Roads Act. Of these trucks 11 000 are new and the remainder have been used in war work, their total value being more than $45 000 000. It is contemplated that other equipment that will

be useful in this work will be turned over by the War Department in the near future.

The Director General of Railroads has announced the decision to reduce the present regularly published tariff rates on specified road-building materials when for use in Federal, State, County, Township, or Municipal Government road work. The reduced rate on all road material will be 10 cents per net ton less than the regularly published tariff rates for the transportation of these materials for commercial uses, but with a minimum charge of 40 cents per net ton, except where the published commercial rate is less. In that case, the regularly published rate shall apply. The freight must be paid by the Government, but the material can be consigned in care of the contractor.

The fact that about 90% of the internal commerce of the country is hauled, first or last, over the highways, makes the Federal highway policy an important factor in transportation and therefore a problem which demands the thought of every engineer.

### Licensing of Engineers

That the question of the licensing of engineers is becoming a vital issue among members of the Profession is evidenced by the manner in which it has been discussed by technical societies in various parts of the United States.

At its Annual Convention, the members of the Ohio Engineering Society recently voted unanimously in favor of such a movement, and it is expected that a bill to license the engineers of the State will soon be presented to the Legislature for action. Two licensing bills have been presented to the State Legislature of Michigan, one of which was drawn up by the Michigan Engineering Society providing for the certification of engineers who engage in certain specific branches of engineering and for the organization of a Board of Examining Engineers; the second one combines the licensing of engineers and architects. It is said to be certain that one of the two bills, or a compromise bill, will be passed by the Legislature. The question has also been discussed in Indiana where a bill has been submitted by the Legislative Committee for the Architects and Structural Engineers of that State. Under the proposed bill, structural engineers will be examined in Structural Engineering and architects in Architecture, but either license will permit of practicing in the whole field of Architecture and Structural Engineering.

The Committee on Legislation of the American Association of Engineers, appointed in 1918 to obtain information concerning bills, proposed and passed upon, for the licensing of engineers in the various States, and to draw up a standard license law, has recently presented a Preliminary Report on the subject. In this report the Committee reviews the existing and proposed bills and outlines the essentials for a new law.

### 11th Engineers Parade in New York City

After long delay in embarkation from France, the 11th Engineers, recruited early in 1917 through the efforts of the Military Engineering Committee of New York, arrived in New York City in two sections, and on April 30th, 1919, paraded down Fifth Avenue which was lined with cheering thousands.

This regiment is famous as the first to sustain casualties in the American Expeditionary Forces and is known as the "Fighting Engineers", because the men threw down their picks and shovels, took up rifles and helped General Byng's British forces hold back the German rush at Cambrai.

The regiment was led by its commander, Col. William Barclay Parsons, M. Am. Soc. C. E., and his staff who marched on foot. The route was down Fifth Avenue from Ninety-sixth Street to Thirty-third Street. The men marched well and carried full equipment with bayoneted rifles. They wore their trench hats. Their physical condition and size, as well as their rapid cadence in marching, created much favorable comment.

Col. Parsons was accompanied by Lieut.-Col. William T. Chevalier, Assoc. M. Am. Soc. C. E. Maj. Charles D. Drew, M. Am. Soc. C. E., led the first battalion, and Maj. B. A. Value, the second.

The parade was reviewed from an official stand at Eighty-second Street by Governor Smith, of New York, Maj.-Gen. David C. Shanks, Commander of the Port of Embarkation, Brig.-Gen. F. V. Abbot, M. Am. Soc. C. E., Acting Chief of Engineers, U. S. A., Mayor Hylan, of New York City, J. Waldo Smith, M. Am. Soc. C. E., Chairman of the Military Engineering Committee, Chas. Warren Hunt, M. Am. Soc. C. E., Chairman, Parade Committee, and others.

Great and continuous applause greeted the regimental colors, the staffs of which were decorated with five silver bands, each denoting a citation.

The parade swung west on Thirty-third Street to the Hotel Pennsylvania where dinner was served to the entire regiment by invitation of the Military Engineering Committee. Col. Parsons was the only speaker, and in the course of his remarks announced that during the regiment's period of service 68 enlisted men had won officers' commissions.

After the dinner and a reception at the 71st Regiment Armory, the regiment entrained for Camp Upton where it was demobilized during the ensuing week.

Col. Parsons, Lieut.-Col. Chevalier, Maj. Hulsart, D. S. C., Maj. Drew, Maj. Buck, and many other officers of the regiment are members of the American Society of Civil Engineers.

The 11th Engineers was recruited in New York City, and the men were very carefully selected for the work they were expected to do.

They were trained at Fort Totten. About 80% of the original members of the regiment returned with it.

The Military Engineering Lectures Committee was self-appointed and numbered among its members prominent representatives in the New York district of the four National Engineering Societies, including their presidents and secretaries, The Engineers' Club, and the General Contractors' Association. In the winter of 1915-16, it organized a course of military engineering lectures given by officers of the Corps of Engineers then assigned to the Eastern Department, U. S. A., by courtesy of Maj.-Gen. Leonard Wood. There were 3 500 registered for these lectures, and the immediate result was the voluntary drilling of considerable numbers and many applications for the first Plattsburg Training Camp.

Following the lectures, the Committee organized the Engineering Division of the Preparedness Parade, in which more than 7 000 took part.

The Committee was strong for preparedness from the start and immediately on the declaration of war, under the direction of the Chief of Engineers, U. S. Army, recruited the 11th Engineers' Regiment. This work was accomplished in less than two weeks from the time the order was given. Great care was exercised in the selection, in order to secure men of the highest class, both physically and mentally, who could be capable of successfully prosecuting any work which might be assigned to them, or, in other words, to carry out the motto of the 11th Engineers "If it can't be done, do it." For this reason it required painstaking efforts on the part of those in charge of enlistment, so that out of 6 000 presenting themselves or making application for enlistment only 1 221, or about 1 in 5 were accepted.

Since the recruiting of the 11th Engineers, the work of the Committee has been confined to assisting the Government authorities in various ways from time to time, including the recruiting of men for special purposes, such as mechanics for the Ordnance Base in France and men for other engineer regiments.

### New York State's New Highway Commissioners

Col. Frederick Stuart Greene, M. Am. Soc. C. E., recently appointed State Highway Commissioner for New York, has completed the appointment of his official staff by naming Paul Schultze, M. Am. Soc. C. E., Irving V. A. Huie, Assoc. M. Am. Soc. C. E., and Mr. Charles Van Amburgh, first, second and third deputies, respectively. Maj. Huie served in France as a member of the First United States Engineers of the Seventy-seventh Division, and will be in charge of maintenance and repairs. He is a graduate of the University of New York and entered the army from the engineers' training camp at Plattsburg. After his first engagement, he was promoted for gallantry.

### City Limits now Fixed by Automobiles and Good Roads

City limits no longer are fixed by municipal ordinance, but by automobiles and good roads, observes a *Bulletin* issued by the U. S. Department of Labor. As a domestic market a city's territory is limited only by the possibilities of motor-truck transportation. Facility and economy in this field depend on the character of roads; the better the roads the bigger the city.

The American city which does not have a market diameter of 200 miles, is not approximating its commercial possibilities; it has not developed its "home market" to its maximum business productiveness. In nine cases out of ten these cities permit their business opportunities to stall in a mudhole.

The United States Government has voted $266 750 000 for Federal aid to States in their road-building programme. This sum either is available or will be by the end of the fiscal year 1921. Under the Federal-aid plan the United States Government stands practically half the cost of construction. If the States, therefore, avail themselves of this opportunity to translate Federal funds into permanent State improvements, the money spent on road construction by States and the the Federal Government to the end of the fiscal year 1921 will be not less than $533 500 000.

Twenty years ago the market limit of the average city was about 10 miles. It was no farther removed from the heart of the town—courthouse square, if you please—than it was possible for a team to pull a loaded wagon on a dirt road and make the round trip between the morning and evening chores. Much is said these days about "seasonable employment," meaning such work as must be done in certain favorable seasons of the year. Seasonable employment is another term for periodic idleness. It will be eliminated in a 100% efficient industrial system. The mud road makes "seasonable business" which means that periodically there is practically no business because roads are impassable. A 100% efficient business system will eliminate periodic suspensions of business activities, even if to do so means the construction of hard-surface roads.

### National Legislative and Departmental Information Service

In response to frequent expressions of need, Engineering Council announces the establishment of a National Legislative and Departmental Information Service for engineers in all branches of the Profession. Information relative to engineering statistics, research, and construction, as well as of matters before Congress involving engineering considerations, will be furnished without charge by addressing the National Service Committee, M. O. Leighton, Chairman, 502 McLachlen Building, Washington, D. C.

## The New Price Revolution

Irving Fisher, Professor of Political Economy at Yale University, read an address before a conference of Governors and Mayors at the White House, Washington, D. C., early in March last, from which the following is abstracted:

"At the present time there is a marked halt in production. Industry is slowing down. Unemployment of labor increases. Some industrial concerns are failing to earn profits, and others are suffering the dissipation of their accrued profits, because, even by shutting their plants down, they can not save certain of their expenses or any of their fixed charges. The Government's revenues, dependent as they are upon the national income, may fall short at the very time we need them most. In brief, we are threatened with a widespread business depression and from peculiar causes, for the unsound conditions usually preceding a widespread business depression are absent.

"The main reason why business is not going ahead better is that most people expect prices to drop. The merchant is selling, but not buying. The manufacturer holds up the purchase of his raw materials. People quote the disparity between present prices and those prevailing 'before the war,' and decide they will not buy much until present prices get down to 'normal.' This general conviction that prices are sure to drop is putting a brake upon the entire machinery of production and distribution. Readjustment waits because we keep on waiting for it. We have waited in vain for over three months. It is interesting to observe that many manufacturers think that prices must come down, including the price of labor; but they are ready to demonstrate to you that their own prices can not come down, nor can they pay lower wages. Almost everything they buy somehow costs twice as much as before the war, and their labor is twice as dear. They can not pay their labor less if labor is to meet the increased cost of living. Now, as a matter of fact, when we investigate almost any individual one of the so-called high prices for industrial products we are likely to find that individually it is not high; that is, it is not high relatively to the rest. Our quarrel is with the general level of prices. * * *

"All prices have risen, but some have risen more, some less, than the average for particular reasons affecting each industry. In some cases an improved organization of both employers and employees has enabled them to combine against the public and take full advantage of the price advance. The war brought about an abnormal demand for certain products like copper and steel, and they advanced faster than the average. The abnormal demand having disappeared, these prices are being adjusted downward. Wheat is a case where demand increased and at the same time certain of the usual sources of supply—Russia, Australia, and Argentina—disappeared, with a resultant abnormal price increase. The closed sources of supply have opened again, and wheat prices in the world market have dropped. In some cases, as in many of the industries making building materials, the war meant a great slackening in demand, an enforced curtailment in use by Government order. In such instances we are likely to see an upward swing in prices as the suppressed demand again makes itself felt. To-

day we are witnessing throughout the country such price readjustments, up and down, but the general price level has shown little sign of falling, as is evidenced by price index numbers. It is apparent to every thoughtful observer that some great force has affected all prices, creating a new standard to which they are all conforming.

"The fundamental practical question confronting business men is whether the general level of prices is going to fall. In my opinion, it is not going to fall much, if at all. We are on a permanently higher price level, and the sooner the business men of the country take this view and adjust themselves to it the sooner will they save themselves and the Nation from the misfortune which will come if we persist in our present false hope.

"The general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. If the number of dollars circulated by cash and by check doubles while the number of goods and services exchanged thereby remains constant, prices will about double.

"The great price changes in history have come about in just this manner. The 'price revolution' of the sixteenth century came upon Europe as a result of the great influx of gold and silver from the mines of the New World. Europe was flooded with new money. More counters were used than before in effecting exchanges and prices became 'high.' People talked then of temporary 'inflation', just as they talk of it now. But it was not temporary; it was a new price level.

"A similar increase in prices all over the world occurred between 1896 and 1914, following the discovery of the rich gold fields of South Africa, Cripple Creek, and Alaska, the invention of the cyanide process in mining, and the vast extension of the use of bank credit. * * *

"Business men should face the facts. To talk reverently of 1913-14 prices is to speak a dead language to-day. The buyers of the country, since the armistice, have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant. The reason is that we are on a new high-price level, which will be found a stubborn reality. Business men are going to find out that the clever man is not the man who waits, but the one who finds out the new price facts and acts accordingly."

### Invitation to Members of the Society Visiting Spokane, Wash.

The Spokane Engineering and Technical Association extends a cordial welcome to any member of the National Engineering Societies, who may be in the city temporarily, to visit the headquarters of the Association. Meetings of committees are held every day except Tuesday and Saturday, and the members of the Association would be glad to welcome visitors at the luncheons in order that they may keep in closer touch with engineering problems in different parts of the United States and broaden their field of acquaintanceship. The time and place of the meetings may be obtained by addressing the Secretary of the Association, A. D. Butler, Assoc. M. Am. Soc. C. E., City Engineer, Spokane, Wash.

### Ordnance Technical Staff Organized

With a view to affording more satisfactory means for originating, designing, developing, testing, and adopting new ordnance, ordnance materials, and other implements of war with the production of which the Army Ordnance Department is charged, the Chief of Ordnance some weeks ago directed the organization in his office of a technical staff, with Col. Colden L'H. Ruggles, Ordnance Department, at its head, and details for the functioning of this organization have about been perfected. The staff includes an ordnance committee, and artillery, ammunition and explosives, aircraft armament and small arms, ordnance theory and instruments and metallurgy, and administration sections. As the representative of the Chief of Ordnance, the Chief of the Technical Staff confers with the Line and the General Staff of the Army regarding types of ordnance desired to be developed, advises the Chief of Ordnance as to the progress of ordnance development in and outside of the Ordnance Department, arranges and supervises a close liaison with and the co-operation and support of the engineering and scientific societies of the country in the development of ordnance engineering, attends trials of ordnance material at proving grounds and in the field and when possible attends trials of ordnance in other services in this country and abroad, reviews and recommends action on all proposed experimental and research work involving improvements in existing types or development of new types of ordnance material, recommends to the Chief of Ordnance new types of ordnance, acts as president of the Ordnance Committee, and attends to many other matters.

One of the most important parts of the staff is the Ordnance Committee. This includes officers of other services detailed as members of the Committee, chiefs of the artillery, ammunition and explosives, aircraft armament and small arms and ordnance theory, instruments and metallurgy sections of the technical staff, the officer in charge of any technical branch of the technical staff when a subject relating to his specialty is under consideration, the executive assistant to the chief of the technical staff, and such other officers of the technical staff as may be designated by its chief for consideration of a particular subject. The Ordnance Committee reviews and recommends action on all proposed experimental and research work relating to ordnance, makes recommendations of new types for development and design, examines, consolidates and acts on equipment lists submitted to it, arranges for approval by General Staff, prescribes tests for acceptance of types of ordnance, attends trials of ordnance, and makes recommendations as to acceptance after tests. Officers of other services, members of the Committee, act in liaison between the technical staff and their respective branches, submit matters for consideration of the Committee that originate in their respective branches, and generally

keep in touch with the specialists of the technical staff regarding work affecting material relating to their respective branches. In this way representatives of the several arms of the service are enabled to participate in the origination, design, development, determination of types, and trials of ordnance they are to use, and those things that those branches indicate that it needs or wants may be reconciled and developed, with the aid of the designing and production experts of the Ordnance Department, within the limits prescribed by technical possibilities. More—much benefit is expected from the co-operation with the scientific societies of the country that is being arranged for. Already liaison has been established with the American Society of Mechanical Engineers, and it is practically certain that the American Society of Electrical Engineers, American Chemical Society, American Society of Automotive Engineers and other organizations will be brought into association with the technical staff. Further, a number of scientists are working individually on certain ordnance problems under the auspices of the technical staff. The line of the Army already has indicated its approval of the system represented by the newly established technical staff, and the chiefs of field artillery and coast artillery have designated officers to represent their branches of the service on the Ordnance Committee.

### New York City Public Service Commission To Be Reorganized

The New York State Senate, without debate, and on a short roll call, unanimously adopted on April 15th, 1919, the plan of Governor Smith for the reorganization of the Public Service Commission in New York City.

On May 3d, 1919, Gov. Smith announced the appointment of Lewis Nixon as regulatory Public Service Commissioner in New York City at a salary of $15 000 per year. The appointment was made immediately after the Governor signed the Foley Bill which provides for a single-headed commission in the First District.

Mr. Nixon has been State Superintendent of Public Works, at $8 000 per year. He is succeeded in that office by Edward S. Walsh who had been his deputy.

Governor Smith announced that the post accepted by Mr. Nixon had been offered to Col. William Barclay Parsons, M. Am. Soc. C. E., who has just returned from France in command of the 11th Engineers, and that Col. Parsons had declined it.

There are two so-called Foley Bills under which the Public Service Commission of New York City, or First District, consisting of five members is to be replaced by two commissioners—one to exercise regulatory functions and the other to have charge of construction. The latter post has not yet been filled.

### Topographic Map of the United States

The *Proceedings* for April, 1919 (page 422), contained a letter urging the rapid completion of the topographic map of the United States, addressed to the Secretary of the Interior by M. O. Leighton, M. Am. Soc. C. E., Chairman of the National Service Committee of Engineering Council. In order to bring the matter up to date and for the information of the membership, a reply to that letter from the Hon. Franklin K. Lane, Secretary of the Interior, is presented herewith:

"Washington, D. C., April 15, 1919.

"Mr. M. O. Leighton, *Chairman*,
"National Service Committee,
"Engineering Council,
"Washington, D. C.

"Dear Mr. Leighton:—I have before me your statement of the essential relation of the topographic mapping of the country to good engineering and the economic development of our resources, and your presentation of the matter strikes me as warranted by the facts of which I am cognizant. An adequate map of the United States at the earliest possible date is of course the programme to be endorsed.

"Your information is correct that the Geological Survey now has available a trained personnel sufficient to permit a large expansion of the Government's activities, in topographic surveys. This increase in number of topographic engineers is a happy by-product of the assistance rendered the Army by the Department of the Interior. As you may know, a summer school was established for training young engineers in military mapping and every method adopted to furnish the Engineer Corps with officers for this specialized service both overseas and in this country. Most of the men so trained are now available to supplement the regular topographic force of the Geological Survey, the members of which are also now returning to their civilian status. For this reason, an annual expenditure of $1 000 000 on the topographic map of the United States is now justified both by the public needs and the ability of this Department to perform this work economically and effectively. In such a programme it is hoped that the States might increase their co-operative contributions to $500 000, especially as the co-operation for the two years past was necessarily interrupted by the military mapping being largely confined to a few border States. I am told that in several States the officials are now urging the completion of the co-operative mapping of their States within the next few years.

"The readjustment of the appropriations for topographic work as between the Department of the Interior and the War Department is not yet complete, but my recommendation to the 65th Congress was for the restoration of the appropriation item for topographic surveys under the Geological Survey to the pre-war figure of $350 000, and my present purpose is to submit a supplemental estimate to the 66th Congress, as you suggest, increasing this to $500 000. The support of this larger programme by Engineering Council, representing as it does the great national engineering societies, will be appreciated.

"Cordially yours,
"Franklin K. Lane."

In connection with this matter, the following resolution concerning topographic mapping, adopted by the Engineers', Architects', and Constructors' Conference at Chicago, Ill., on April 25th, 1919, may also be of interest to the membership:

"The Engineers, Architects and Constructors Conference on National Public Works, composed of the representatives appointed by 74 National, State and Local Organizations, with an aggregate membership of over 100 000 men, realizes the great importance of adequate maps for the economical planning and construction of a large proportion of engineering works.

"With much wisdom the Federal and State Governments are now entering upon a programme of highway construction which constitutes the greatest engineering project ever undertaken by our Government, and which will result in the expenditure of many billions of dollars of public funds in the next decade. This highway construction, as well as many other important public and private engineering undertakings, such as drainage and reclamation projects and others—in the aggregate of tremendous magnitude—demand for economical accomplishment the best type of information such as is afforded by the Topographic Maps issued by the Federal Government in co-operation with many of the States. These maps are completed for only about 40% of the area of the country. The past rate of progress, if continued, will require between 80 and 100 years to complete the maps for the whole United States.

"It is apparent to this Conference that by having such maps the saving in the cost of engineering works to be constructed during a very small portion of this time will more than pay for the making of these maps. Therefore, it will be greatly to the public advantage if the completion of these maps can be hastened as rapidly as men can be trained to do the accurate work required.

"In view of the foregoing statements, which express the sense of this Conference,

"*Be it Resolved:* That the facts be presented to the President and to the Congress, and that they be urged to make adequate provision for the entire work of completing the Topographic Map of the United States in the shortest possible time, compatible with requisite accuracy; and

"*Be it Further Resolved:* That inasmuch as Engineering Council has already taken up this matter with Federal Government Departments, their efforts to hasten the completion of the Topographic Map be endorsed by this Conference and that this Resolution be entrusted to them to present to the President, The Secretary of the Interior, the members of the Congress, and to make such other disposition of it as will, in their judgment, further the end desired."

### Annual Meeting of the American Society for Testing Materials

The Annual Meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., June 24th-27th, 1919. The Hotel Traymore will be headquarters. A topical discussion on magnetic analysis will be one feature of the programme.

### Five Generations Crowded into Five Years

The Victor Saw Works, of Springfield, Mass., published recently in the *American Machinist* the advertisement quoted below, which is reproduced here as being especially appropriate to the times:

"In change of conditions the gap that divides 1919 from 1914 is as great as the gap that divides the Twentieth Century from the Eighteenth.

"The man who looks to a return of the conditions of 1914 in adjusting business or social relations is as sadly out of joint as if he looked to a return of the conditions of 1800.

"Think of things these short five years have witnessed!

"Machines loaded with men and cargoes fly through the air for long distances at the rate of a hundred miles an hour. Ships travel under the seas at speeds that rival the fastest sailing vessels of a hundred years ago. Men on the surface of the earth talk through wireless telephones to men flying a mile in air.

"Great tonnage of freight is moved by trucks over open roads for greater distances and at higher speeds than were achieved by our early railroads.

"Ships that required years for construction are built in a month. Time of production for commodities of all kinds has been cut and cut again. Processes of manufacture have been revolutionized.

"America has passed from a debtor nation, owing billions, to a creditor nation, lending billions. Thirty thousand security holders in America have expanded into thirty million.

"The impossibilities of sixty months ago have become common occurrences.

"Financially, commercially, socially, the world has been turned upside down.

"*We are in a new world.* The past and its conditions have gone never to return. We are living in a new era. It's time we realized it.

"If you have something to sell—go ahead and sell it. If you need anything—go ahead and buy it. You will not be able to either buy or sell at the price level of five years ago. Stop thinking about it. Do business."

### American Railroad Association

The American Railway Association has been reorganized as the American Railroad Association, comprising five sections devoted to operating, engineering, mechanical, traffic and transportation matters. The mechanical section includes the former American Railway Master Mechanics' Association and the Master Car Builders' Association, whose work is combined with that of similar organizations in other departments, through the parent organization. A circular has been issued by the new association giving the personnel of the general committee which will have charge of the convention at Atlantic City, N. J., June 18th to 25th, 1919, inclusive. Thirty-one committees will report at the convention.

### New York-New Jersey Vehicular Tunnel

On April 11th, 1919, Governor Smith of New York State signed the bill appropriating $1 000 000 as that State's share toward the construction of the New York-Jersey City Vehicular Tunnel. As Governor Edge of New Jersey has also signed a bill appropriating a like amount as New Jersey's share toward this work, the inauguration of the project seems to be assured.

The tunnel is to be built under the Hudson River between New York City and Jersey City, N. J., for the sole use of pedestrians and vehicles, and it is estimated that its total cost, one-half of which is to be borne by each State, will be $12 000 000. The work is to be done by contract as directed by the New York State Bridge and Tunnel Commission in co-operation with the New Jersey Bridge and Tunnel Commission. These Commissions are also authorized to contract for the joint operation, repair, and maintenance of the tunnel as well as the collection of tolls.

The New York State Commission is composed of Messrs. George R. Dyer, Chairman, E. W. Bloomingdale, Vice-Chairman, McDougall Hawkes, Alexander J. Shamberg, and John H. Delaney, with Morris M. Frolich as Secretary.

This tunnel project was the subject of an informal discussion at a meeting of the Society on March 19th, 1919, which was opened by Edward A. Byrne, M. Am. Soc. C. E. This discussion is published in this number of *Proceedings*.*

### Association of Members of American National Engineering Societies in Cuba

The organization, on February 21st, 1919, of the Association of Members of American National Engineering Societies in Cuba, with headquarters in Havana, is announced. Membership in the Association is restricted to the American National Engineering Societies, and the object is to foster the interests of the Engineering Profession in Cuba by bringing the members of the various National Societies on the Island into closer touch with one another and with the social and professional opportunities accruing from such association in a foreign land.

The officers of the Association for 1919 are: President, Luther Wagoner, M. Am. Soc. C. E.; Vice-President, George H. Nolan, M. Am. Soc. C. E.; Secretary, T. Carlile Ulbricht, Mem. Am. Soc. M. E.; and Treasurer, Wallace R. Lee, Mem. Am. Soc. M. E. Until permanent headquarters are secured, the meetings of the Association are being held at the rooms of the American Club.

* See p. 249 of Papers and Discussions.

### Memoirs of Deceased Members Requested

An Associate Member calls attention to the fact that the 1919 Year Book chronicles the names of more than 550 deceased members, memoirs of whom have never been published by the Society. He suggests that the attention of the membership be called to the matter with a view to securing from them data or complete memoirs of these deceased members so as to bring the subject as nearly up to date as possible.

The Publication Committee therefore requests the membership to look over these 550 names and to send to *Proceedings* any data they may have or can secure regarding men in the list whom they have known.

It should be stated that as soon as the death of a member is officially reported to the Secretary's office, an effort is promptly made to secure data for a memoir from the family and friends of the deceased. It is failure to respond to these requests which has resulted in the lack of memoirs mentioned.

### Business Training for Engineers

The Commissioner of Education has issued a call on behalf of the Conference Committee on Commercial Engineering recently appointed by him, for a public conference on business training for engineers and engineering training for students of business. This conference, national in scope and in character and fully representative of all interests, will be held at the New Willard Hotel in Washington, D. C., on Monday and Tuesday, June 23d and 24th, 1919. All educational institutions, commercial organizations, manufacturing associations, and educational and engineering societies are cordially invited to co-operate and to designate one or more representatives to attend the conference. Prominent engineers, educators, and business men will be invited to discuss the following major topics: Business Training for the Engineer; Engineering Training for Commercial Enterprises; Significance of the War Experience for Engineering Education; Training of the Engineer for Overseas Engineering Projects.

### Appointment in Civil Engineering

The Board of Governors of the University of Manitoba, Winnipeg, Man., Canada, announces that it will proceed shortly to appoint a Professor of Civil Engineering to take charge of the Department, at an initial salary of $3 500 per annum. Applications for the position, accompanied by a full statement of training and experience and ten copies of testimonials, will be received by the Secretary of the Board of Governors, up to July 15th, 1919.

### Committees and Representatives of the Society Appointed at Last Meeting of Board of Direction

The following is a summary of committees and representatives of the Society appointed at the meeting of the Board of Direction, April 14th-15th, 1919:

A. S. Baldwin, M. Am. Soc. C. E., as delegate to Conference of National Service Committee of Engineering Council, Chicago, Ill., April 23d-25th, 1919, to Consider Establishment of a National Department of Public Works, etc.

Messrs. George S. Webster, H. H. Porter, and Anson Marston as representatives on the Engineering Division of the National Research Council.

John R. Freeman, M. Am. Soc. C. E., to convey the salutations of the Society to the Engineering Congress in Java, in 1920.

Robert A. Cummings, M. Am. Soc. C. E., as a representative of the Society on the Board of Directors of the American Welding Society.

### New Public Service Commissioner for New York State

On April 15th, 1919, Governor Smith sent to the New York State Senate the name of his Counsel, Joseph A. Kellogg, of Glens Falls, for member of the up-State Public Service Commission, to succeed Jerome L. Cheney, now a Deputy Attorney-General. Mr. Kellogg, who is a former Supreme Court Justice, conducted Gov. Smith's campaign from the Syracuse Headquarters of the Democratic Committee last fall. The Governor's first official act was to name him as Counsel, at $7 500 per year. As Public Service Commissioner he will receive $15 000 for a term of five years.

### Engineering Societies to Assist Joint Employment Service of Federal, State, and Civic Bodies

During the war the four national engineering societies, Civil, Mining, Mechanical and Electrical, under the auspices of the American Engineering Service Committee of Engineering Council rendered valuable aid to the Government, placing many technical men in the Army, Navy, and industries of the country at a time when they were greatly needed. With the signing of the armistice the need for Government service naturally ended, but the greater problem of returning to civil employment the discharged soldier and sailor at once

presented itself, and is daily becoming graver and more urgent. To meet this the four societies organized the Engineering Societies' Employment Bureau with the secretaries of the societies as directors.

At the invitation of Col. Arthur Woods, U. S. A., Special Assistant to the Secretary of War, the Engineering Societies have been requested to bring to the attention of their members the availability of not only the professional men who are returning from France, but also the supply of miners, mechanics, and other skilled labor among the enlisted men, and to emphasize that Army discipline has not only made these men quicker thinkers but also more willing and obedient workers. Their army service has been conducive to regular habits and clean living.

Further, the military instruction which they have received has increased the mens' powers of concentration. The War Department desires to bring before the employers of skilled labor the fact that the employment of discharged soldiers will be advantageous to the employer and economically beneficial to the country.

The following is a list of the vocations of the men who are now returning:

Auto Mechanic
Blacksmith
Boilermaker
Bricklayer
Carpenter
Air or Gas Compressor Operator
Concrete or Cement Worker
Construction Foreman and Superintendent
Crane Operator
Draftsman
Electrician
Engineer
Engineman and Fireman
Foundryman
Gasoline Engineman or Repairman
Gas Plant Worker
Hydraulic Press Operator
Instrument Maker
Laborer (Classified)
Lineman and Cableman
Machinist and Mechanic
Metal Finisher
Millwright
Miner or Quarry Worker
Painter
Pipefitter
Photographer
Plasterer
Railroad Operating Man
Refrigeration Operator
Rigger and Cordage Worker
Sheet Metal Worker
Structural Steel Worker
Telegraph and Wireless Man
Transportation Man
Water Supply Man
Welder and Cutter

To this end members of the Society are requested to take up the matter actively and to write to W. V. Brown, Manager of the Engineering Societies Employment Bureau, 29 West 39th Street, New York City, specifying opportunities for placing men in any of the industries in which they are acquainted.

### Classification and Compensation of Railway Engineers

In response to a request of Engineering Council, the Board on Wages and Working Conditions of the U. S. Railroad Administration gave a hearing to engineers, in Washington, D. C., March 31st, 1919, which was continued on the following day. Classification and compensation of technical engineers on the staffs of the railway systems under Government control were discussed and many data presented.

There appeared for Engineering Council, Messrs. Francis Lee Stuart and Frank H. Clark, of the Railroad Section of Council's Committee on Classification and Compensation of Engineers, and Mr. M. O. Leighton in charge of Council's Washington office. For the American Association of Engineers there were present Secretary C. E. Drayer and Messrs. W. C. Bolin, Willard Beahan, C. D. Calvert, F. W. Strickler, and J. B. Parsons. The full Board was present and manifested unusual interest in the entire proceedings, taking copious notes and asking many pertinent and important questions.

The first day's session having been devoted chiefly to the interests of the Civil Engineers, on the second day attention was directed more particularly to the Mechanical, Electrical, and Signal Engineers. Owing to the lack of witnesses available by Engineering Council and the Association, Chairman Gaines, of the Board, arranged for the appearance of engineers connected with the Government railways.

Various engineers were called as witnesses from time to time, and a few regional directors were requested to give their opinions. A clear case seemed to have been established for the feasibility and desirability of classifying the technical engineering positions of the railway staffs, and establishing standard compensations for them, possibly with a provision for a minimum for inexperienced men and a maximum for experienced engineers in the several ranks.

## ANNOUNCEMENTS

**The Reading Room of the Society is open from 9 A. M. to 10 P. M., every day, except Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day; during July and August, it is closed at 6 P. M.**

## FUTURE MEETINGS

**June 4th, 1919.—8.30 P. M.**—This will be a regular business meeting of the Society, the programme for which will be announced later.

## ANNUAL CONVENTION

The Forty-ninth Annual Convention of the Society will be held in the "Twin Cities" of St. Paul and Minneapolis, Minn., from June 17th to 20th, 1919, inclusive.

The general arrangements for the Convention are in the hands of the following Committees:

*Committee of the Board of Direction*

W. L. Darling, *Chairman*

Edward E. Wall — Chas. Warren Hunt

*Local Committee*

R. D. Thomas, *Chairman*

| | |
|---|---|
| W. C. Armstrong | W. N. Jones |
| F. H. Bass | F. C. Sheneiion |
| R. B. C. Bement | Horace E. Stevens |
| F. W. Cappelen | Howard E. Stevens |
| Oscar Claussen | P. E. Thian |
| William de la Barre | W. T. Walker |
| F. E. House | G. L. Wilson |
| W. H. Hoyt | L. P. Wolff |

A circular giving full information as to the general programme, transportation, hotel rates, etc., was issued on May 15th, 1919.

## CONTRIBUTIONS TO *PROCEEDINGS* REQUESTED BY PUBLICATION COMMITTEE

The Committee on Publications will be glad to receive communications of general interest to the Society, and will consider them for publication in *Proceedings* in "Items of Interest". This is intended to cover letters or suggestions from our membership covering matters which are not of a technical character. Such communications, however, must not be controversial or commercial.

## ROLL OF HONOR

Now that the war is over, the monthly publication in *Proceedings* of the Roll of Honor has been discontinued. It is planned to publish later for permanent record a list of all the members of the American Society of Civil Engineers whose names have appeared on this list.

## ENGINEERING SOCIETIES EMPLOYMENT BUREAU

Engineering Societies Employment Bureau, established December 1st, 1918, as an activity of Engineering Council, is managed by a board made up of the Secretaries of the four Founder Societies, funds for its maintenance being provided by these Societies. The Bureau already is co-operating with engineering organizations in all parts of the country and with the Professional Section of the United States Employment Bureau. It is desirous of increasing such co-operation by working with local engineering associations and clubs. The work of the Bureau since its inception has been largely in the line of securing employment for men retiring from government war service. Members of the American Society of Civil Engineers who desire to register with this Bureau should apply for further information, registration forms, etc., to Walter V. Brown, Manager, Engineering Societies Employment Bureau, 16th Floor, Engineering Societies Building, 29 West 39th Street, New York City.

## SEARCHES IN THE LIBRARY

As the Library of the American Society of Civil Engineers has been merged in the Engineering Societies Library, requests for searches, copies, translations, etc., should be addressed to the Director, Engineering Societies Library, 29 West 39th Street, New York City, who will gladly give information concerning the charges for the various kinds of service. For a more comprehensive statement in regard to this matter see pages 314 and 315 of *Proceedings* for March, 1919.

## PAPERS AND DISCUSSIONS

Members and others who take part in the oral discussions of the papers presented are urged to revise their remarks promptly. Written communications from those who cannot attend the meetings should be sent in at the earliest possible date after the issue of a paper in *Proceedings.*

All papers accepted by the Publication Committee are classified by the Committee with respect to their availability for discussion at meetings.

Papers which, from their general nature, appear to be of a character suitable for oral discussion will be published as heretofore in *Proceedings,* and set down for presentation to a future meeting of the Society, and, on these, oral discussions, as well as written communications, will be solicited.

All papers which do not come under this heading, that is to say, those which from their mathematical or technical nature, in the opinion of the Committee, are not adapted to oral discussion, will not be scheduled for presentation to any meeting. Such papers will be published in *Proceedings* in the same manner as those which are to be presented at meetings, but written discussions only will be requested for subsequent publication in *Proceedings* and with the paper in the volumes of *Transactions*.

The Board of Direction has adopted rules for the preparation and presentation of papers, which will be found on page 35 of the Year Book for 1919.

## LOCAL ASSOCIATIONS OF MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

### San Francisco Association, Organized 1905.

E. J. Schneider, President; Nathan A. Bowers, Secretary-Treasurer, 502 Rialto Building, San Francisco, Cal.

The San Francisco Association of Members of the American Society of Civil Engineers holds regular bi-monthly meetings, with banquet, and weekly informal luncheons. The former are held at 6 P. M., at the Engineers' Club, 57 Post Street, on the third Tuesday of February, April, June, August, October, and December, the last being the Annual Meeting of the Association.

Informal luncheons are held at noon, every Wednesday, at the Engineers' Club, where special tables are reserved for members and guests of the Association.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in San Francisco, and any such member will be gladly welcomed as a guest.

(Abstract of Minutes of Meetings)

**February 12th, 1919.**—A special meeting was held at the Engineers' Club to welcome home Maj. John D. Galloway after his year's service in France. After a dinner at which the guests of honor were Maj. Galloway and Maj. Dillman, Maj. Galloway was introduced to about 80 members and guests by Maj. Dillman, who had served with him in France.

Maj. Galloway had been attached to Gen. Pershing's headquarters at Chaumont, with the Intelligence Section. With the use of a set of maps and charts, the preparation of which he had supervised in France, he gave an interesting account of the method of gathering advance information relative to the plans, facilities, and movements of the enemy. He described the transportation systems used by the enemy in battle, outlined the studies for plans of bombing enemy lines of communication and war industrial centers, and concluded with a review of the battles of 1918.

The address was illustrated by a number of lantern slides showing maps of the various battles and views of aeroplanes and of photographs taken from aeroplanes.

Adjourned.

**February 18th, 1919.**—The meeting was called to order at the Engineers' Club at 6 P. M.; President E. J. Schneider in the chair; Nathan A. Bowers, Secretary; and present, also, 65 members and guests.

A letter was read from Chas. Warren Hunt, Secretary of the Society, relative to the work and meetings of the Committee on Development, which was followed by discussion of the subject by Mr. H. L. Haehl, the representative from the District on that Committee.

The Secretary read a communication from the San Francisco Chapter of the American Institute of Architects urging co-operation in the matter of a new building ordinance for San Francisco. After discussion by Messrs. Nishkian and Brunnier, it was voted, on motion, duly seconded, to refer the matter to a committee previously appointed to consider the subject.

The matter of the 1919 dues of members discharged from the service was explained, and returning members were urged to get in touch with the activities of the Association.

The proposed formation of a San Francisco Chapter of the American Association of Engineers was reported.

President Schneider presented the Annual Address in which he reviewed briefly the opportunities before the Association during 1919 and urged the co-operation of individual members. He summarized the points of his address under three classifications, namely, (1) membership; (2) public relations; and (3) entertainment; and suggested that committees be appointed to take charge of the activities under the classifications outlined.

On motion, duly seconded, the President was authorized to appoint such committees, and their members were announced as follows: Membership, Messrs. Brunnier, Bumsted, Legare, Derleth, and Marx; Public Relations, Messrs. Dillman, Markwart, Gilman, Riffle, and Parsons; and Entertainment, Messrs. Muhs, Dewell, and Popert.

On motion, duly seconded, the following resolution was adopted: "That it is the sense of this Association that the American Society of Civil Engineers should be urged to pass a resolution requesting the Congress of the United States to appropriate $1 000 000 000 for the construction of public roads and other public works, to be apportioned in an equitable manner among the various States, the funds to be administered by a Board of Public Works such as that now being proposed to the Administration by Engineering Council."

The Secretary was instructed to send this resolution to the Secretary of the Society.

The topic for discussion at the meeting was "Concrete Ships." Mr. Leslie W. Comyn, President of Comyn, Mackall and Company, spoke on the "Why" of concrete ships. Mr. Victor H. Poss, who designed the hull of the *Faith*, described the essential features of design and construction of that vessel, illustrating his talk with lantern slides. Mr. H. J. Brunnier, Principal Assistant Engineer, Concrete Ship Division, Emergency Fleet Corporation, explained the work of that organization in detail and, with the aid of slides, took the audience for a visual tour of the five shipyards of the Concrete Ship Division.

Adjourned.

On Saturday afternoon, March 8th, 1919, the members of the Association visited the Government concrete ship yard on the Oakland Estuary at the invitation of Capt. H. D. Hynds, Assoc. M. Am. Soc. C. E. The number who accepted the invitation totaled 125 members and guests who came from points as far away as Merced, Eureka, and Sacramento. The vessels inspected were two 7 500-ton tankers, 420 ft. long, on both of which the form work and the placing of the reinforcing steel were practically completed, and the concrete was being poured for one of them.

**Colorado Association, Organized 1908.**

L. R. Hinman, President; A. N. Miller, Secretary-Treasurer, 1400 West Colfax Avenue, Denver, Colo.

The meetings of the Colorado Association of Members of the American Society of Civil Engineers (Denver, Colo.) are held on the second Saturday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary. The meetings are usually preceded by an informal dinner. Members of the American Society of Civil Engineers will be welcomed at these meetings.

Weekly luncheons are held on Wednesday at 12.30 P. M., at Daniels and Fisher's.

Visiting members are urged to attend the meetings and luncheons.

(Abstract of Minutes of Meeting)

**March 8th, 1919.**—The meeting was called to order at the Denver Athletic Club; Vice-President E. C. Jansen in the chair; A. N. Miller, Secretary; and present, also, 12 members and 26 guests.

The minutes of the meeting of February 8th, 1919, were read and approved.

The Secretary read a letter from Chas. Warren Hunt, Secretary of the Society, containing a detailed report concerning the selection of the delegates from the Society to the Joint Engineering Congress held in Paris in December, 1918, which letter was a reply to certain resolutions adopted by the Duluth Association.

Mr. F. A. Banks addressed the meeting on "The Jackson Lake Dam, Wyoming", illustrating his remarks with lantern slides.

Adjourned.

**Atlanta Association, Organized 1912.**

T. P. Branch, President; J. T. Wardlaw, Secretary-Treasurer, 1530 Healey Bldg., Atlanta, Ga.

Informal luncheons are held for members of the Association on the last Monday of each month, at 12.30 P. M. The place is not fixed, but this information will be furnished on application to the Secretary.

**Baltimore Association, Organized 1914.**

H. G. Perring, President; Charles J. Tilden, Secretary-Treasurer, The Johns Hopkins University, Baltimore, Md.

**Cleveland Association, Organized 1914.**

F. D. Richards, President; George H. Tinker, Secretary-Treasurer, 516 Columbia Building, Cleveland, Ohio.

**Detroit Association, Organized 1916.**

T. A. Leisen, President; Clarence W. Hubbell, Secretary, 2348 Penobscot Building, Detroit, Mich.

The regular meetings of the Association are held on the second Friday of December, April, and October, the last being the Annual Meeting.

**District of Columbia Association, Organized 1916.**

A. P. Davis, President; John C. Hoyt, Secretary-Treasurer, U. S. Geological Survey, Washington, D. C.

**Duluth Association, Organized 1917.**

W. B. Patton, President; Walter G. Zimmermann, Secretary, Wolvin Building, Duluth, Minn.

The regular meetings of the Association are held at noon on the third Monday of each month (usually at the Kitchi Gammi Club), with luncheon, followed by a short business session and the reading of papers. Visiting members of the American Society of Civil Engineers can secure from the Secretary definite information relative to the meetings, at which they will be welcomed. The Annual Meeting is held on the third Monday in May.

(Abstract of Minutes of Meeting)

**April 21st, 1919.**—The meeting was called to order at the Kitchi Gammi Club; President W. B. Patton in the chair; Walter G. Zimmermann, Secretary; and present, also, 16 members and 1 guest.

The minutes of the meeting of March 24th, 1919, were read and approved.

The Secretary presented a communication from Secretary Hunt relative to the selection of members from each Local Association to assist the Publication Committee in determining the value of papers received by the Society. On motion, duly seconded, this matter was referred to the Local Board of Directors.

Letters were also read from Messrs. Henry R. Buck, of Hartford, Conn., and G. M. Braune, of Cincinnati, Ohio, relative to the proper procedure for the formation of Local Associations.

On motion, duly seconded, it was ordered, that all members of the Association be assessed one dollar in order to replenish the treasury.

Mr. Hoyt reported for the Committee appointed to investigate the matter of the establishment of a working fund for Engineering Council, that provision had been made for such fund and that the Committee would report further on the matter at the next meeting of the Association.

Mr. Pickles reported briefly in regard to the Annual Convention of the Society, and requested that a new member of the Local Committee be appointed to take the place of Mr. E. R. Lewis resigned. President Patton subsequently appointed Col. Francis A. Pope as a member of the Committee.

On motion, duly seconded, the Secretary was ordered to extend formal invitations to the Duluth Engineers' Club and the Engineers' Club of Northern Minnesota to assist the Association is looking after and entertaining members of the Society in attendance at the Annual Convention.

Mr. Clark reported for the Local Committee on Development relative to the action taken by the Cleveland Association in regard to the terms of office of the officers of the Development Committee of the Society, which report stated that although the Association was in sympathy with the Cleveland Association in this matter, no action should be taken at this time in view of the fact that another meeting of the Development Committee would be held in the near future. On motion, duly seconded, the report was accepted, and the Secretary instructed to write to the Cleveland Association to that effect.

Mr. Ash presented a progress report of the Library Committee and requested that the Committee be continued, which request, on motion, duly seconded, was granted.

Mr. Clark reported for the Entertainment Committee that arrangements were being made with Mr. Newton, of Milwaukee, Wis., to address the Association on the work of the Fabricated Ship Corporation of Milwaukee, at the Annual Meeting in May.

A progress report was presented by Mr. Clapper for the Committee on Licensing of Engineers, and, on motion, duly seconded, the Committee was continued.

A Special Committee consisting of Messrs. Taylor, Clapper, and Coe, presented a discussion of the paper entitled, "Hydrated Lime and Its Use in Concrete", by Mr. W. E. Hawley. On motion, duly seconded, the discussion was ordered printed and distributed to the membership.

The meeting was addressed by Maj. Coe, who supplemented Col. Pope's talk at the meeting of March 24th, 1919, by giving facts and figures pertaining to the results accomplished by the engineers in war service. Maj. Coe also related some of his personal experiences while in the service in France.

Adjourned.

**Illinois Association, Organized 1916.**

H. J. Burt, President; Edgar S. Nethercut, Secretary-Treasurer, 1735 Monadnock Blk., Chicago, Ill.

The regular meetings of the Association are held on the second Monday of March, June, September, and December, the last being the Annual Meeting. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

**Louisiana Association, Organized 1914.**

Arsène Perrilliat, President; Eugene F. Delery, Secretary, 503 City Hall Annex, New Orleans, La.

The regular meetings of the Association are held at The Cabildo, New Orleans, La., on the first Monday of January, April, July, and October.

**Nebraska Association, Organized 1917.**

*————————, President; Homer V. Knouse, Secretary-Treasurer, 200 City Hall, Omaha, Nebr.

Regular meetings of the Association are held on the first Saturday of each month, except July and August, and at such places as may be appointed from time to time by the Executive Committee. The Annual Meeting is held in Lincoln, Nebr., on the second Friday in January.

Visiting members of the Society are especially urged to communicate with the Secretary when in the city.

**Northwestern Association, Organized 1914.**

Ralph D. Thomas, President; W. N. Jones, Secretary, City Engineer's Office, City Hall, Minneapolis, Minn.

The meetings of the Association are held bi-monthly, alternating between St. Paul and Minneapolis, on the third Friday of each month. Information as to the time and place of such meetings will be furnished on application to the Secretary.

**Philadelphia Association, Organized 1913.**

F. Herbert Snow, President; Henry T. Shelley, Secretary, 416 City Hall, Philadelphia, Pa.

The regular meetings of the Association are held at the Engineers' Club of Philadelphia, 1317 Spruce Street, on the first Monday in January, April, and October, the last being the Annual Meeting.

**Pittsburgh Association, Organized 1917.**

Robert A. Cummings, President; Nathan Schein, Secretary-Treasurer, 1510 Carson Street, Pittsburgh, Pa.

The Annual Meeting of the Association is held on the first Monday in October. The time and place of other meetings are not fixed, but this information will be furnished on application to the Secretary.

**Portland, Ore., Association, Organized 1913.**

E. Burslem Thomson, President; C. P. Keyser, Secretary, 318 City Hall, Portland, Ore.

The Annual Meeting of the Association is held on the second Friday in January. Other meetings are called by the President and are usually convened on Friday evenings. The place is not fixed, but this information may be obtained on application to the Secretary. All members of the American Society of Civil Engineers are cordially invited to attend the meetings.

(Abstract of Minutes of Meetings)

**February 10th, 1919.**—The meeting was called to order at the University Club; President E. B. Thomson in the chair; C. P. Keyser, Secretary; and present, also, 21 members.

Mr. G. M. Post, representing the Local Chapter of the American Institute of Architects, addressed the meeting in favor of Senate Bill No. 180, relating to the licensing of architects in the State of Oregon.

* Mr. Adna Dobson, the President of the Association, died on May 4th, 1919.

Mr. A. N. Haley also addressed the meeting urging the appointment of a Mr. Blackwell, of Seattle, on the commission to investigate the settlement of the St. John's grain elevator.

The minutes of the meeting of January 17th, 1919, were read and approved.

The Committee on City Planning, having completed its work, and its Chairman, Mr. J. P. Newell, having been elected President of the City Planning Commission, on motion, duly seconded, was discharged.

The Secretary read a communication from G. B. Hegardt, Chief Engineer of the Dock Commission, asking the Association to appoint a board of engineers to investigate the settlement of the St. John's grain elevator. On motion, duly seconded, the President was instructed to name ten engineers, recommending the selection of not less than three, but preferably five, to act as a board to pass on the question of subsidence.

On motion, duly seconded, a communication from the St. Louis Association recommending the assessment of one dollar per member to carry on the work of the National Service Committee of Engineering Council, at Washington, D. C., was laid on the table.

A communication from the Duluth Association asking for exchange of all resolutions of general interest was read, and, on motion, duly seconded, was ordered to be filed.

The meeting was then opened to a general discussion of the pending legislation affecting engineers. After a statement by the Secretary that he had failed to get copies of the bills mailed to the members of the Association, it was suggested that some member in favor of House Bill No. 263 (proposing the registration of professional engineers), address the meeting on the benefits to be derived by the Engineering Profession and by the public through this bill. Messrs. Laurgaard and Stanley spoke briefly in favor of the bill and Messrs. Dieck and Henny against it. It was then moved and seconded that the Association appoint a committee to take the necessary steps to defeat House Bill No. 263 and Senate Bill No. 180.

After discussion by Messrs. Stevens, Dieck, Stanley, Laurgaard, Cunningham, Hoffmark and Mieth, it was moved and seconded that the Secretary send out letter ballots on House Bill No. 263 to all members of the Society residing in Oregon, but the amendment was lost. The original motion was then put and carried, and President Thomson appointed Messrs. Mason and Henny as the committee.

On motion, duly seconded, it was decided that the Association take no action on Senate Bill No. '46 (County Surveyor and Roadmaster legislation).

Adjourned.

**April 4th, 1919.**—The meeting was called to order at 8 P. M., at the University Club; President Thomson in the chair; C. P. Keyser, Secretary; and present, also, 16 members.

The minutes of the meeting of March 20th, 1919, were read and approved.

A report was read from the Committee appointed to consider memberships in the Oregon State Chamber of Commerce and the American

Association for the Advancement of Science, which recommended that the Association decline both invitations. On motion, duly seconded, the report was adopted and the Committee discharged.

A progress report was presented by the Committee on the preparation of a questionnaire of personal record, and it was stated that a final report would be presented within two weeks.

Mr. M. E. Reed reported verbally on Mr. B. C. Ball's dinner to Calvin M. Rice, Secretary of the American Society of Mechanical Engineers, on March 25th, 1919, at which the officers of the Association were invited guests. It was stated that a conference of the Presidents of the various local technical bodies would be called, with a view to organizing a general local engineering association, or, perhaps, combining with the Oregon Society of Engineers. Nathan A. Bowers, Secretary of the San Francisco Association, also reported on Mr. Rice's reception in Seattle and British Columbia.

Mr. D. C. Henny addressed the meeting on "Some Features of Reclamation of the Florida Everglades", which was followed by informal discussion. On motion, duly seconded, Mr. Henny was accorded the thanks of the Association for his address.

It was moved and seconded that the Secretary be instructed to send a copy of the minutes of the meeting of the Association of February 10th, 1919, to the Secretary of the Society with the request that he have printed in *Proceedings* as much as pertains to the action of the Association relative to House Bill No. 263, and, further, to ask who furnished the information relative thereto which appears on page 304 of March, 1919, *Proceedings*. It was then moved that the motion be amended directing the Secretary to suggest to Dr. Hunt that he publish only such actions of the Association as are reported by its Secretary or other accredited source of information, which motion was carried.

On motion, duly seconded, it was decided that the Association go on record as favoring a Department of Public Works in the administration of the National Government and to further the movement by all means.

Adjourned.

**St. Louis Association, Organized 1888 (Constitution Approved by Board, 1914).**

J. A. Ockerson, President; C. W. S. Sammelman, Secretary-Treasurer, 300 City Hall, St. Louis, Mo.

The Annual Meeting of the Association, for the election of officers and for the transaction of business, is held on the fourth Monday in November. Two meetings each year, for the presentation and discussion of technical papers, are held in the Auditorium of the Engineers Club of St. Louis and are open to members of the Associated Societies. Other "get-together" meetings are held regularly for dinner or luncheon on the fourth Monday of each month except July, August, and November.

**San Diego Association, Organized 1915.**

W. C. Earle, President; Ralph Wueste, Secretary-Treasurer, Bonita, Cal.

**Seattle Association, Organized 1913.**

L. M. Grant, President; Phil A. Franklin, Secretary, 1409 East 65th St., Seattle, Wash.

The regular meetings of the Association, with luncheon, are held at the Engineers' Club, Arctic Building, Third Avenue and Cherry Street, at 12.15 P. M., on the last Monday of each month.

Special evening meetings are held from time to time for the purpose of discussing important topics, and information concerning these meetings may be had by addressing the Secretary. All members in any grade of the American Society of Civil Engineers are cordially invited to attend the meetings when in the vicinity, and, if located in this District for any length of time, their membership in the Association will be appreciated.

**Southern California Association, Organized 1914.**

George G. Anderson, President; Floyd G. Dessery, Secretary, 511 Central Building, Los Angeles, Cal.

The Southern California Association of Members of the American Society of Civil Engineers (Los Angeles, Cal.) holds regular monthly meetings on the second Wednesday of each month, the December meeting being the Annual Meeting.

Informal luncheons in connection with the Joint Technical Societies of Los Angeles are held at 12.15 P. M. every Thursday at the Broadway Department Store Café.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in Los Angeles, and any such member will be gladly welcomed as a guest at any of the meetings or luncheons.

(Abstract of Minutes of Meeting)

**April 9th, 1919.**—The meeting was called to order at 6.30 P. M., at Christopher's Café; President Anderson in the chair; F. G. Dessery, Secretary; and present, also, 35 members and 16 guests.

F. E. Trask, Chairman of the Committee on Reconstruction and Development, presented a detailed progress report on the work of this Committee.

President Anderson and Mr. W. K. Barnard reported that as a result of a conference, at San Francisco, with representatives of the various technical societies of Northern California, on the registration of engineers in California, an agreement had been made by all participants to withdraw their support of Senate Bill No. 559, entitled "An Act to Register Engineers in the State of California", and to unify all efforts and work for legislation to be presented to the State Legislature at its 1921 session.

F. D. Howell, Chairman of the Committee on Publicity, reported in detail on the subject, outlining efforts and suggestions of engineers to secure proper publicity in engineering matters.

Robert A. Cummings, of Pittsburgh, Pa., Chairman of the Special Committee on the Bearing Value of Soils for Foundations, etc., of the Society, addressed the meeting on the work of his Committee, and requested members of the Association to aid in its work by submitting information on the Physics of Soils.

Mr. Frederick C. Noble, of New York City, member of the Committee on Development of the Society, also addressed the meeting relative to the work of that Committee.

The chief topic for discussion before the meeting was the subject of Flood Control as outlined by the Programme Committee. A paper by Dr. Ford A. Carpenter, U. S. Meteorologist, on "Precipitation in Southern California Illustrated by Storms in Recent Years in Los Angeles County", was presented by the author and illustrated with lantern slides. The second paper entitled, "Flood Run-Off", was read by Mr. F. C. Ebert, Hydrographer of the U. S. Geological Survey. A general discussion of the subject followed the reading of the papers.

On motion, duly seconded, it was decided to present a resolution looking to the furtherance of the efforts of the Weather Bureau and the Hydrographic Branch of the U. S. Geological Survey, by securing greater financial aid and pledging the help of the Association along this line.

Adjourned.

**Spokane Association, Organized 1914.**

Peter Mogensen, President; Charles E. Davis, Secretary, City Engineer's Office, Spokane, Wash.

The regular meetings of the Association are held on the second Friday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary.

Visiting members are invited to attend the meetings.

**Texas Association, Organized 1913.**

R. J. Potts, President; J. H. Brillhart, Secretary, Care, Mosher Mfg. Co., Dallas, Tex.

**Utah Association, Organized 1916.**

A. B. Villadsen, President, 304 Dooly Bldg., Salt Lake City, Utah.

The Annual Meeting of the Association is held on the first Wednesday in April. The time of other meetings is not fixed, but this information will be furnished on application to the President.

## PRIVILEGES OF ENGINEERING SOCIETIES EXTENDED TO MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Members of the American Society of Civil Engineers will be welcome in the Reading Rooms and at the meetings of many engineering societies in all parts of the world. A list of such societies will be found on pages 41 and 42 of the Year Book of the Society for 1919.

# NEW BOOKS*

(From April 1st to April 30th, 1919)

**The statements made in these notices are taken from the books themselves, and this Society is not responsible for them.**

## DONATIONS TO ENGINEERING SOCIETIES LIBRARY

**PRINCIPLES OF RADIOTELEGRAPHY.**

Prepared in the Extension Division of the University of Wisconsin by Cyril M. Jansky. (Engineering Education Series.) N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 242 pp., 179 illus., 9 x 6 in., cloth. $2.00.

A textbook in which the use of mathematical expressions is limited, while an attempt has been made to explain the principles involved so fully that a reader unable to follow the mathematical demonstrations may still acquire some understanding of the subject. A considerable portion of the book is devoted to a discussion of electromagnetic theory and apparatus, in order that the student may acquire an intelligent idea of the principles of the operation of radiotelegraphic apparatus.

**PUNCHES AND DIES:**

Layout, Construction, and Use. By Frank A. Stanley. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 434 pp., 618 illus., 9 x 6 in., cloth. $4.00.

This book has been written to provide die-makers, tool-makers and tool draftsmen with certain definite information heretofore not available as a whole. Almost 90% of the material, the author states, has not been published before.

**AEROPLANE CONSTRUCTION AND ASSEMBLY.**

By J. T. King and N. W. Leslie. Minneapolis, Press of the William Hood Dunwoody Industrial Institute. 115 pp., 77 illus., 5 pl., 9 x 6 in., cloth. $1.50.

This work is intended as a practical manual for mechanics engaged in constructing and rigging airplanes and as a guide to instructors. Airplane assembly, construction, and materials, and the theory of flight are discussed.

**IRON AND STEEL:**

(A Pocket Encyclopedia), Including Allied Industries and Sciences. By Hugh P. Tiemann. With an Introduction by Henry Marion Howe. 2d edition. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 514 pp., 7 x 4 in., flexible cloth. $4.00.

In a volume of pocket size, the author provides a combination of dictionary, encyclopedia, and handbook of the iron and steel industries, intended for the metallurgist. The number of terms, and the text also, have been increased about one-half, the chief additions being more extended discussions of heat treatment, physical properties and testing, and of metallographic subjects.

**PHYSICS AND CHEMISTRY OF MINE VENTILATION:**

A Practical Handbook for Vocational Schools, and for Those Qualifying for Mine Foreman and Mine Inspector Certificates. By Joseph J. Walsh. 2d edition. N. Y., D. Van Nostrand Co., 1918. 219 pp., illus., tables, 8 x 5 in., cloth. $2.00.

A textbook of theory and practice for students with limited mathematical knowledge. This edition has been thoroughly revised, and a chapter on the sampling and analysis of mine gases has been added.

*Unless otherwise specified, books in this list have been donated by the publishers.

**MINING PRACTICES.**

Compiled from the *Engineering and Mining Journal* by the Editorial Staff. N. Y., McGraw-Hill Book Co., Inc., Sole Selling Agents, 1919. 105 pp., 56 illus., 11 tables, 12 x 9 in., cloth. $1.50.

These articles have been selected to illustrate the range in conditions that must be met in mining operations and to indicate in both a general and a specific way how mining practices are developing.

**THE MINERAL DEPOSITS OF SOUTH AMERICA.**

By Benjamin L. Miller and Joseph T. Singewald. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 598 pp., illus., maps, 9 x 6 in., cloth. $5.00.

An account of the economic geology of the countries of South America, based on an extended visit by the authors in 1915, and a study of the literature. It forms a digest of the available information on the mineral deposits of the continent. Selected bibliographies are appended to each chapter, and an adequate index is provided.

**QUANTITATIVE ANALYSIS.**

By Edward G. Mahin. 2d edition. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 605 pp., 122 illus., tables, 8 x 5 in., cloth. $3.50.

The author has endeavored to produce a volume which would occupy a position between the complete reference work and the bare outline of laboratory exercises. It covers the material that he wishes to take up in his college courses, and, at the same time, presents a theoretical and practical discussion of the subject. In addition to the presentation of the general subject, a section on the analysis of industrial products and raw materials is included. This edition has been carefully revised and partly rewritten, and new material has been added.

**INDUSTRIAL GOODWILL.**

By John R. Commons. N. Y., McGraw-Hill Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 213 pp., 3 charts, 8 x 6 in., cloth. $2.00.

The author discusses the present-day problems of labor and capital, their relations to each other, and the methods of solving them, which have been practiced or proposed. Contents: Commodity; Machinery; Goodwill; The Public; Democracy; Solidarity; Theory and Practice; Security; Labor Market; Insurance; Health; The Shop; Education; Loyalty; Personality; Depression; The World.

**OFFICE MANAGEMENT:**

Its Principles and Practice Covering Organization, Arrangement, and Operation, with Special Consideration of the Employment, Training, and Payment of Office Workers. By Lee Galloway. 2d printing. N. Y., The Ronald Press Co., 1919. 701 pp., 97 illus., 1 pl., 9 x 6 in., flexible leather. $6.00.

This book is intended as an exposition of the basic principles of office administration in its widest sense, with adequate illustration by examples of successful practice.

**OFFICE ADMINISTRATION.**

By J. William Schulze. 1st edition, 2d impression. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 295 pp., illus., folded chart, 8 x 5 in., cloth. $3.00.

Written to present a thorough discussion of the principles and methods which underlie efficient and economical management, for use by executives and students of business, it embodies the author's added experience and observation, and is intended to replace his earlier book, "The American Office".

**SEWAGE DISPOSAL.**

By Leonard P. Kinnicutt, C. E. A. Winslow, and R. Winthrop Pratt. 2d edition, rewritten. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 547 pp., 141 illus., 136 tables, 9 x 6 in., cloth. $4.00.

This volume offers a general survey of the problem from the various viewpoints of the chemist, the sanitary biologist, and the engineer, with particular reference to the conditions of American practice. The aim has been to discuss rather fully the fundamental principles of chemistry and bacteriology which are involved and to include the more important aspects of the engineering works designed to carry them into operation. This edition has been completely rewritten so as to bring in new data and recent viewpoints on all the topics treated. Several chapters have been much enlarged, and several new ones have been added.

## DONATIONS TO THE READING ROOM

**MAN TO MAN:**

The Story of Industrial Democracy. By John Leitch. N. Y., B. C. Forbes Company (copyright, 1919). 249 pp., 8 x 5 in., cloth. $2.00.

In order to call the attention of both employer and employee to the importance of establishing a happier understanding between management and men in the industrial world, the author has set down in this book something of his theory and a few of the cases arising out of his conception of Industrial Democracy.

**WATERPROOFING ENGINEERING**

For Engineers, Architects, Builders, Roofers and Waterproofers. By Joseph Ross. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 10 + 442 pp., 104 illus., 41 tab., 9 x 6 in., cloth. $5.00.

The preface states that in writing this book an effort has been made to explain past and present methods and materials of water-proofing, investigate their efficiency, draw helpful conclusions, and, where possible, establish standard methods and materials for general waterproofing, and emphasize the value of careful study of the whole subject, especially by engineers engaged in design. The Contents are: Need and Function of Waterproofing; Systems of Waterproofing; Impervious Roofing; Waterproofing Expansion Joints in Masonry; Waterproofing Materials; Waterproofing Implements and Machinery; Technical and Practical Tests on Waterproofing; Waterproofing Specifications; Practical Recipes and Special Formulas; Waterproofing Applied; Cost Data on Materials, Improvements, and Labor; Practical Tables; Appendix I, Explanation of Mechanical Analysis for Grading Concrete Aggregates; Appendix II, Concrete in Sea Water; Appendix III, Report on Waterproofing—American Society for Testing Materials; Appendix IV, Glossary of Terms Used in the Waterproofing Industry; Appendix V, References; Index.

**THE BUILDING ESTIMATOR'S REFERENCE BOOK:**

A Practical and Thoroughly Reliable Book for Contractors and Estimators Engaged in Estimating the Cost of and Constructing All Classes of Modern Buildings; Giving the Actual Labor Costs and Methods Employed in the Erection of Some of Our Present Day Structures, Together with All Necessary Material and Labor Quantities Entering Into the Cost of All Classes of Buildings. By Frank R. Walker. 3d edition. Chic., Frank R. Walker Company, 1919. 7 + 2831 pp., illus., diag., tab., 7 x 5 in., morocco. (Gift of the Author.)

The aim of this book is to furnish building contractors, estimators, engineers, architects, etc., with correct methods of estimating the detailed costs of buildings and other construction work. This edition has been thoroughly revised, and the data are arranged so that local prices and wages can be inserted in all instances, resulting in unit costs, that are thoroughly dependable. It is also the author's intention to issue monthly supplements giving additional estimating data, together with the current prices of the basic materials in the principal markets and trade centers, in order to cover fluctuating prices.

IRRIGATION ENGINEERING.

By Arthur Powell Davis and Herbert M. Wilson. 7th ed., rev. and enl. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 23 + 640 pp., 250 illus., 59 tab., 9 x 6 in., cloth. $4.50.

In re-writing and re-arranging the subject-matter for this edition of this work which is devoted largely to American irrigation practice, much that is new, the preface states, has been added. The radical changes are stated to be the treatment of soils, plant food, operation and maintenance, and other lines of work in which the duties of the irrigation engineer come in contact with those of the irrigator, such as the preparation of land, the duty of water, and its application to the land. At the end of nearly every chapter there is a bibliography relating to the subject discussed in that chapter, and, in closing, the authors have devoted a chapter to standard specifications for some of the most important work required in irrigation construction, including those for the Arrowrock Dam.

## MEMBERSHIP

(From April 4th to May 8th, 1919.)

### ADDITIONS

MEMBERS

| | | Date of Membership. |
|---|---|---|
| Ayers, Augustine Haines. Care, U. S. Reclamation Service, Powell, Wyo. | Assoc. M<br>M. | Oct. 3, 1911<br>April 14, 1919 |
| Bartoccini, Astolfo. Gen. Contr. (Sawyers & Bartoccini). 59 Fifth Ave., New York City | Assoc. M.<br>M. | May 6, 1903<br>April 14, 1919 |
| Cairns, George Holloway. City Engr. and Commr. of Streets; Cons. Engr., Gainesville, Fla | | Jan. 13, 1919 |
| Clow, Percival. Structural Engr., Westinghouse, Church, Kerr & Co., Inc., 37 Wall St., Room 900, New York City | | April 14, 1919 |
| Corkran, Wilbur Sherman. Maj., Engrs., U. S. A., E. O. T. S., Camp A. A. Humphreys, Va.; Address, Crisfield, Md. | Assoc. M.<br>M. | Mar. 13, 1917<br>April 14, 1919 |
| Delano, Edward Warren. Engr. of Railroad Constr., Central Constr. Corporation, 1661 Darley Ave., Baltimore, Md. | | April 14, 1919 |
| Emerson, George Dana. 162 Walnut St., Brookline, Mass. | Assoc. M.<br>M. | June 3, 1908<br>April 14, 1919 |
| Everett, Martin Ryerson. Pres., Martin R. Everett, Inc., 275 Emmett St., Newark, N. J. | | April 14, 1919 |
| Fleming, Joseph Hamilton. Designing and Cons. Civ. Engr. (Braun, Fleming, Knollman & Prior), 233 South High St., Columbus, Ohio | Assoc. M.<br>M. | Sept. 11, 1917<br>April 14, 1919 |
| Freeman, Ralph. Managing Partner (Sir Douglas Fox & Partners), 56 Moorgate St., London, E. C. 2, England | | Mar. 11, 1919 |
| Goodman, Charles. Gen. Contr. (Heyman & Goodman Co.), 875 West 180th St., New York City | Assoc. M.<br>M. | June 3, 1915<br>April 14, 1919 |
| Harman, John James. Civ. Engr., Walworth Mfg. Co., Boston, Mass. | | April 14, 1919 |
| Hunt, Horace Sinclair. (Fargo Eng. Co.), 201 McBride St., Jackson, Mich. | Assoc. M.<br>M. | Oct. 7, 1914<br>April 14, 1919 |
| Kallasch, Winfred Miller. Gen. Supt., Leonard Eng. Co., 860 McCormick Bldg., Chicago, Ill. | Assoc. M.<br>M. | May 6, 1914<br>Mar. 11, 1919 |
| Kinsey, William Ambrose. Cons. and Contr. Engr., 192 Market St., Newark, N. J. | Assoc. M.<br>M. | May 31, 1910<br>April 14, 1919 |
| McClintock, Hallett Edward. Asst. City Engr., 1810 Manderson St., Omaha, Nebr. | Assoc. M.<br>M. | Dec. 6, 1915<br>April 14, 1919 |

MEMBERS (*Continued*)

| | | Date of Membership. |
|---|---|---|
| McCOMB, DANA QUICK. Maj., Engrs., U. S. A.; Engr. Officer in Local Chg. of Heavy Fortification and Land Defense Constr., Corregidor, Philippine Islands | Assoc. M.<br>M. | Dec. 6, 1915<br>Jan. 14, 1919 |
| MORRISON, CHRISTOPHER GEORGE. Dist. Engr., Alaska Road Comm., P. O. Box T, Juneau, Alaska | Jun.<br>Assoc. M.<br>M. | Oct. 5, 1909<br>Mar. 1, 1913<br>Mar. 11, 1919 |
| NORTHAM, MANLEY PEROE. Efficiency Engr., The Emerson Engrs., Care, The Aluminum Co. of America, Massena, N. Y. | Assoc. M.<br>M. | Oct. 29, 1912<br>April 14, 1919 |
| PERRY, ARTHUR IRVING. Commander, U. S. N. R. F., Commanding U. S. S. *Gloucester*, and Harbor Entrance Patrol Forces, 3d Naval Dist., 831 Lincoln Pl., Brooklyn, N. Y. | | April 14, 1919 |
| PUFF, CHARLES FREDERICK, JR. Asst. Chf. Engr., Bureau of Highways, 5125 West 15th St., Philadelphia, Pa. | Assoc. M.<br>M. | April 1, 1914<br>April 14, 1919 |
| REYNOLDS, WILLIAM LEROY. Chf. Engr., Water, Sewers, and Gas, U. S. Explosives Plant C, Nitro, W. Va. | Assoc. M.<br>M. | Feb. 4, 1914<br>April 14, 1919 |
| SMALL, JAMES HAMPDEN, JR. Const. Q. M., Richmond Bag Loading Plant, Richmond, Va. | Jun.<br>Assoc. M.<br>M. | Mar. 31, 1903<br>July 9, 1912<br>April 14, 1919 |
| SWAREN, JOHN WILLIAM. Maj., Engrs., U. S. A.; Secy., Engr. Training Schools, Camp A. A. Humphreys, Va. | Assoc. M.<br>M. | June 11, 1917<br>April 14, 1919 |
| VAWTER, JOHN TERRELL. Maj., Engrs., U. S. A.; Asst. Chf. Engr., Emergency Fleet Corporation, 369 Pine St., San Francisco, Cal. | | Mar. 11, 1919 |
| WAGNER, EDWARD LAWRENCE. 320 Fifth Ave., New York City. | | April 14, 1919 |
| WEBSTER, ROYAL SYLVESTER. Asst. Chf. Engr. and Asst. Engr., Way and Works, Havana Cent. R. R., Apartado 970, Havana, Cuba | Jun.<br>Assoc. M.<br>M. | Oct. 6, 1903<br>Feb. 4, 1913<br>April 14, 1919 |
| WONDERS, JAMES CREW. Dist. Engr., 5th Dist., U. S. Office of Public Roads, Omaha, Nebr. | | April 14, 1919 |
| WOODWARD, ROLAND. P. O. Box 941, Columbus, Ga. | | Mar. 11, 1919 |

ASSOCIATE MEMBERS

| | |
|---|---|
| ABEL, ARTHUR HENRY. Asst. Engr., Comm. of Public Docks, Foot of Stark St., Portland, Ore. | April 14, 1919 |
| BAILEY, WILLIAM CARLYLE. Asst. Engr., Bureau of Highways, Dept. of Public Works, City of Philadelphia, 1223 Wakeling St., Frankford, Philadelphia, Pa. | Nov. 26, 1918 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership. |
|---|---|---|
| BLAKESLEE, HAROLD LAW. Contr.'s Engr., C. W. Blakeslee & Sons, 58 Waverly St. (Res., 598 George St.), New Haven, Conn. | Jun. | Dec. 5, 1911 |
| | Assoc. M. | April 14, 1919 |
| BROOKS, RAYMOND WENTWORTH. Asst. Field Engr., Roadway Party 9, Interstate Commerce Comm.; Interstate Bldg., Kansas City, Mo. | Jun. | Jan. 2, 1912 |
| | Assoc. M. | Mar. 11, 1919 |
| BROWN, EUGENE BAKER. Res. Engr., California Highway Comm., Gaviota, Cal. | | April 14, 1919 |
| BROWN, JESSE FRED. 507 Interstate Bldg., Kansas City, Mo. | | April 14, 1919 |
| BROWNE, WOLSTAN ELLIOT. 228 Washington St., Abington, Mass. | | April 14, 1919 |
| CHANDLER, EMERSON LAWRENCE. Asst. Div. Engr., The Miami Conservancy Dist., Dayton, Ohio. | Jun. | Nov. 8, 1909 |
| | Assoc. M. | Mar. 11, 1919 |
| COLLINS, JOHN LAMBERT. Engr. with Stone & Webster, 29 Market St., Lowell, Mass. | | Mar. 11, 1919 |
| CRANE, JACOB LESLIE, JR. Prin. Asst. Engr., Gannett, Seelye & Fleming, 204 Locust St., Harrisburg, Pa. | Jun. | Dec. 3, 1913 |
| | Assoc. M. | April 14, 1919 |
| ELSTON, ALLAN VAUGHN. Cons. Engr. (Wood, Elston & Witten), 209 Lynch Bldg., Tulsa, Okla. | | April 14, 1919 |
| FITZGERALD, WILLIAM EDWARD. Supt., New Brunswick Filtration Plant, 12 Stratford Pl., New Brunswick, N. J. | Jun. | May 31, 1916 |
| | Assoc. M. | April 14, 1919 |
| GRAETER, GEORGE CHRISTIAN. Capt., Engrs., U. S. A., Service of Light Rys., U. S. A. P. O. 703, Am. Exp. Forces, Abainville, Meuse, France; Address, 28 North State St., Sullivan, Ind. | | Oct. 9, 1917 |
| GRANNIS, JAMES KIDWELL. 724 Lindsay Bldg., Dayton, Ohio. | Jun. | Sept. 6, 1910 |
| | Assoc. M. | April 14, 1919 |
| HULL, WILLIAM DELONEY. 119 Chestnut St., Dansville, Va. | | Mar. 11, 1919 |
| JACOBS, NATHAN BERND. Treas., Morris Knowles, Inc., 1200 Jones Bldg., Pittsburgh, Pa. | Jun. | Sept. 11, 1917 |
| | Assoc. M. | April 14, 1919 |
| LABOON, JOHN FRANCIS. (Chester & Fleming), 1111 Union Bank Bldg., Pittsburgh, Pa. | | April 14, 1919 |
| LANE, EMORY WILSON. Computer, Miami Conservancy Dist., Dayton, Ohio. | Jun. | Mar. 4, 1914 |
| | Assoc. M. | April 14, 1919 |
| LATENSER, JOHN, JR. Archt. (John Latenser & Sons), 632 Bee Bldg., Omaha, Nebr. | | April 14, 1919 |
| LINDLEY, EDWARD SEARLES. Executive Engr., Indian Public Works Dept., Punjab Irrig. Branch, Care, Thomas Cook & Son, Bombay, India. | | Mar. 11, 1919 |
| LUCEY, JOHN. Acting Dist. Engr., Northern Dist., Obras Publicas, Santiago, Dominican Republic. | | Jan. 13, 1919 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership. |
|---|---|---|
| McKean, Harry Parker. Asst. Engr., The Mountain States Telephone & Telegraph Co., 417 Wyoming Bldg., Denver, Colo. | Jun. | June 6, 1911 |
| | Assoc. M. | Nov. 26, 1918 |
| Morris, Samuel Brooks. Chf. Engr., Pasadena Water Dept., City Hall, Pasadena, Cal. | Jun. | Mar. 2, 1915 |
| | Assoc. M. | April 14, 1919 |
| Moulton, Arthur Garland. Supt., Thompson-Starrett Co., 175 West Jackson Boulevard, Room 539 (Res., 5048 Woodlawn Ave.), Chicago, Ill. | | April 14, 1919 |
| Nevius, Searle Brown. Insp. of Hulls and Machinery, and Estimator, U. S. Shipping Board, Emergency Fleet Corporation, 170 Perry St., Oakland, Cal. | Jun. | Oct. 1, 1912 |
| | Assoc. M. | Mar. 11, 1919 |
| Nichols, Thomas Flint. 419 Fleming Bldg., Phœnix, Ariz. | | April 14, 1919 |
| Palli, Walter Christian. Asst. Engr., Ill. Cent. R. R., Valuation Dept., 6528 Greenwood Ave., Chicago, Ill. | | April 14, 1919 |
| Root, William Francis Stanton. Capt., Engrs., U. S. A., Care, Section Engr., Base Section No. 1, Am. Exp. Forces, St. Nazaire, France; Address, 50 West 2d St., Mount Vernon, N. Y. | | Jan. 13, 1919 |
| Rose, John Gansovertte. Asst. Engr., Lyman E. Bishop, 2615 Argyle Pl., Denver, Colo. | | April 14, 1919 |
| Sawin, Sanford Wales. Marshallton, Del. | | Mar. 11, 1919 |
| Scruggs, Edwin Lyle. 902 Realty Bldg., Charlotte, N. C. | | April 14, 1919 |
| Sheets, Frank Thomas. Bridge Engr., State Div. of Highways, Springfield, Ill. | | April 14, 1919 |
| Siebert, Christian Ludewig. Capt., San. C., U. S. A.; Camp San. Engr., Camp Dix, N. J. | | April 14, 1919 |
| Sigmund, Benjamin Joseph. Dist. Representative, Truscon Steel Co., 810 Commonwealth Bldg., Philadelphia, Pa. | | April 14, 1919 |
| Smith, Erwin Weir. Asst. Technological Supt., The Roxana Petroleum Co., Drawer 82, Mineral Wells, Tex. | | Jan. 13, 1919 |
| Smith, Richard Bennett. 59 Selden Ave., West, Detroit, Mich. | Jun. | Jan. 6, 1915 |
| | Assoc. M. | Oct. 8, 1918 |
| Stanton, Thomas Elwood, Jr. Prin. Asst. Div. Engr., California Highway Comm., 207 California Fruit Bldg., Sacramento, Cal. | | Jan. 13, 1919 |
| Stevenson, Albert Lester. Progress Engr., U. S. Shipping Board, Emergency Fleet Corporation, 4910 Arch St., Philadelphia, Pa. | | April 14, 1919 |
| Stocker, Howard Raymond. Asst. Engr., Pennsylvania State Dept. of Health, Harrisburg; Address, Box 177, Camp Hill, Pa. | | Nov. 26, 1918 |

ASSOCIATE MEMBERS (*Continued*)

| | | Date of Membership. |
|---|---|---|
| TALBOT, KENNETH HAMMET. Western Mgr., Koehring Machine Co., 31st and Concordia Ave., Milwaukee, Wis. | Jun. | Oct. 7, 1914 |
| | Assoc. M. | Mar. 11, 1919 |
| TEBBETS, JAMES HARGRAVES. Mech. Engr., Plant Eng. Dept., Bethlehem Shipbuilding Corporation, Ltd., P. O. Box 346, South Bethlehem, Pa. | | April 14, 1919 |
| TINGLEY, FRANCIS. Engr. of Way, Altoona & Logan Val. Elec. Ry., Altoona, Pa. | Jun. | Jan. 3, 1911 |
| | Assoc. M. | April 14, 1919 |
| VEATCH, FRANCIS MONTGOMERY. Acting Engr., Kansas State Board of Health, Lawrence, Kans. | Jun. | Jan. 6, 1915 |
| | Assoc. M. | April 14, 1919 |
| WAY, WILLIAM FLOYD. 1st Lieut., Engrs., U. S. A., Care, D. of C and F, A. P. O. 717, Am. Exp. Forces, France; Address. R. F. D. No. 2, Box 196, Seattle, Wash. | Jun. | Sept. 3, 1913 |
| | Assoc. M. | Mar. 11, 1919 |
| WEIR, CARL LESLIE. 2309 Crotona Ave., New York City. | | April 14, 1919 |
| WHITNEY, FREDERICK CLIFFORD. Designing Engr., Ford, Bacon & Davis, 1540 Felicity Ave., New Orleans, La. | | April 14, 1919 |
| WHITNEY, JAMES THEODORE. Director, Whidden-Beekman Co., 100 Boylston St., Boston, Mass. | | April 14, 1919 |
| WIERSEMA, HARRY ANTHONY. Care, Morgan Eng. Co., Goodwyn Inst., Memphis, Tenn. | | April 14, 1919 |
| WOODWORTH, PAUL HENRY. Superv. Plant Engr., Div. of Shipyard Plants, Emergency Fleet Corporation, Care, The Colonial, Lancaster Ave. and City Line, Philadelphia, Pa. | | April 14, 1919 |
| WOOLLEY, WILLIAM EDWARD. Asst. Engr.'s Dept., Walthamstow Urban Dist. Council, 118 Queen's Rd., Walthamstow, London, E. 17, England. | | Mar. 11, 1919 |
| WRIGHT, HERBERT JAMES. Plant Engr., The Barrett Co., Chemical Dept., Frankford (Res., 1219 Chelten Ave., Oak Lane), Philadelphia, Pa. | | May 15, 1917 |

JUNIORS

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|---|---|
| BAER, BERNARD EDWARD. Capt., Engrs., U. S. A., U. S. Disciplinary Barracks, Fort Leavenworth, Kans. | Mar. 11, 1919 |
| GRASSMAN, HERBERT STUYVESANT. Care, Y. M. C. A., Bedford Ave. and Monroe St., Brooklyn, N. Y. | Oct. 8, 1918 |
| PUGH, ISAAC WILLIAM. Efficiency Engr., United Rys. & Elec. Co. of Baltimore, 1509 Continental Trust Bldg., Baltimore, Md. | Mar. 11, 1919 |
| ROGOW, SYDNEY. 14 Morningside Ave., New York City. | April 14, 1919 |

## REINSTATEMENTS

MEMBERS

| | Date of Reinstatement. |
|---|---|
| ROSS, FLORIAN GAIE. | April 15, 1919 |

ASSOCIATE MEMBERS

| | Date of Reinstatement. |
|---|---|
| Werbin, Israel Vernon | April 15, 1919 |

## RESIGNATIONS

MEMBERS

| | Date of Resignation. |
|---|---|
| Herring, Willard E. | April 15, 1919 |
| Root, Charles Wilber | April 15, 1919 |

ASSOCIATE MEMBERS

| | |
|---|---|
| Luzzatto, Joseph Giovanni | April 15, 1919 |
| Merriman, Fred Knights | April 15, 1919 |
| O'Donnell, John Aloysius | April 15, 1919 |
| Rennell, Henry Hurd | April 15, 1919 |
| Rosenberg, Friedrich | April 15, 1919 |
| Turner, Homer Root | April 15, 1919 |

ASSOCIATES

| | |
|---|---|
| Atwell, Harry Hurd | April 15, 1919 |

JUNIORS

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|---|---|
| Allaire, Douglas Anthony | April 15, 1919 |
| Buzzell, Ralph Waldo | April 15, 1919 |
| Moylan, Leonard Kyran | April 15, 1919 |

## DEATHS

Bean, Paul Jones. Elected Junior, May 2d, 1911; Associate Member, December 31st, 1913; died January 25th, 1919.

Brainard, Owen. Elected Member, October 3d, 1906; died April 2d, 1919.

Bright, Charles Edwin. Elected Associate Member, December 3d, 1902; died April 3d, 1919.

Jeme, Tien Yow. Elected Member, November 30th, 1909; died April 24th, 1919.

Kellogg, Norman Benjamin. Elected Junior, February 6th, 1878; Member, July 3d, 1895; died November, 1918.

Kirstein, Paul Robert. Elected Associate Member, May 15th, 1917; died October 17th, 1918.

Mackay, Angus Robert. Elected Associate Member, October 29th, 1912; died June 30th, 1918.

Matson, Thomas Hatcher. Elected Associate Member, October 1st, 1913; date of death unknown.

Nichols, Lewis Abel. Elected Member, October 5th, 1892; died March 5th, 1919.

Obermeyer, Walter Scott. Elected Junior, April 7th, 1915; Associate Member, April 17th, 1917; date of death unknown.

Whittet, Rufus Mason. Elected Associate Member, May 2d, 1911; Member, November 4th, 1914; died December 10th, 1918.

**Total Membership of the Society, May 8th, 1919, 9 039.**

## MONTHLY LIST OF RECENT ENGINEERING ARTICLES OF INTEREST

(March 22d to May 1st, 1919)

NOTE.—*This list is published for the purpose of placing before the members of this Society, the titles of current engineering articles, which can be referred to in any available engineering library, or can be procured by addressing the publication directly, the address and price being given wherever possible.*

### LIST OF PUBLICATIONS

*In the subjoined list of articles, references are given by the number prefixed to each journal in this list:*

(2) *Journal,* Engrs. Club of Phila., Philadelphia, Pa.
(3) *Journal,* Franklin Inst., Philadelphia, Pa., 50c.
(4) *Journal,* Western Soc. of Engrs., Chicago, Ill., 50c.
(5) *Journal,* Eng. Inst. of Canada, Montreal, Que., Canada.
(6) *Journal,* Am. Inst. of Archts., Washington, D. C., 50c.
(8) *Stevens Indicator,* Hoboken, N. J., 50c.
(9) *Industrial Management,* New York City, 25c.
(11) *Engineering* (London), W. H. Wiley, 432 Fourth Ave., New York City, 25c.
(12) *The Engineer* (London), International News Co., New York City, 35c.
(13) *Engineering News-Record,* New York City, 15c.
(15) *Railway Age,* New York City, 15c.
(16) *Engineering and Mining Journal,* New York City, 15c.
(17) *Electric Railway Journal,* New York City, 10c.
(18) *Railway Review,* Chicago, Ill., 15c.
(19) *Scientific American Supplement,* New York City, 10c.
(20) *Iron Age,* New York City, 20c.
(21) *Railway Engineer,* London, England, 1s. 2d.
(22) *Iron and Coal Trades Review,* London, England, 6d.
(24) *American Gas Engineering Journal,* New York City, 10c.
(25) *Railway Mechanical Engineer,* New York City, 20c.
(26) *Electrical Review,* London, England, 4d.
(27) *Electrical World,* New York City, 10c.
(28) *Journal,* New England Water-Works Assoc., Boston, Mass., $1.
(29) *Journal,* Royal Soc. of Arts, London, England, 6d.
(32) *Mémoires et Compte Rendu des Travaux,* Soc. Ing. Civ. de France, Paris, France.
(33) *Le Génie Civil,* Paris, France, 1 fr.
(36) *Cornell Civil Engineer,* Ithaca, N. Y.
(42) *Proceedings,* Am. Inst. Elec. Engrs., New York City, $1.
(43) *Annales des Ponts et Chaussées,* Paris, France.
(45) *Coal Age,* New York City, 10c.
(46) *Scientific American,* New York City, 15c.
(47) *Mechanical Engineer,* Manchester, England, 3d.
(54) *Transactions,* Am. Soc. C. E., New York City, $12.
(55) *Mechanical Engineering:* Journal, Am. Soc. M. E., New York City, $10.
(56) *Transactions,* Am. Inst. Min. and Metallurgical Engrs., New York City, $6.
(57) *Colliery Guardian,* London, England, 5d.
(58) *Proceedings,* Engrs.' Soc. of W. Pa., 2511 Oliver Bldg., Pittsburgh, Pa., 50c.
(59) *Proceedings,* American Water-Works Assoc., Troy, N. Y.
(60) *Municipal and County Engineering,* Indianapolis, Ind., 25c.
(61) *Proceedings,* Western Railway Club, 225 Dearborn St., Chicago, Ill., 25c.
(62) *American Drop Forger,* Thaw Bldg., Pittsburgh, Pa., 10c.
(63) *Minutes of Proceedings,* Inst. C. E., London, England.
(64) *Power,* New York City, 10c.
(65) *Official Proceedings,* New York Railroad Club, Brooklyn, N. Y., 15c.
(66) *Gas Journal,* London, England, 6d.
(67) *Cement and Engineering News,* Chicago, Ill., 25c.
(71) *Journal,* Iron and Steel Inst., London, England.
(71*a*) *Carnegie Scholarship Memoirs,* Iron and Steel Inst., London, England.
(72) *American Machinist,* New York City, 15c.
(73) *Electrician,* London, England, 18c.
(74) *Transactions,* Inst. of Min. and Metal., London, England.
(75) *Proceedings,* Inst. of Mech. Engrs., London, England.
(77) *Journal,* Inst. of Elec. Engrs., London, England, 5s.
(83) *Gas Age,* New York City, 15c.
(85) *Proceedings,* Am. Ry. Eng. Assoc., Chicago, Ill.
(86) *Engineering and Contracting,* Chicago, Ill., 10c.
(87) *Railway Maintenance Engineer,* Chicago, Ill., 10c.

(89) *Proceedings,* Am. Soc. for Testing Materials, Philadelphia, Pa., $5.
(90) *Transactions,* Inst. of Naval Archts., London, England.
(91) *Transactions,* Soc. of Naval Archts. and Marine Engrs., New York City.
(92) *Bulletin,* Soc. d'Encouragement pour l'Industrie Nationale, Paris, France.
(93) *Revue de Métallurgie,* Paris, France, 4 fr. 50.
(96) *Canadian Engineer,* Toronto, Ont., Canada. 10c.
(98) *Journal,* Engrs. Soc. of Pa., Harrisburg, Pa., 30c.
(99) *Proceedings,* Am. Soc. of Municipal Improvements, New York City, $2.
(100) *Professional Memoirs,* Corps of Engrs., U. S. A., Washington, D. C., 50c.
(101) *Metal Worker,* New York City, 10c.
(103) *Mining and Scientific Press,* San Francisco, Cal., 10c.
(104) *The Surveyor and Municipal and County Engineer,* London, England, 6d.
(105) *Chemical and Metallurgical Engineering,* New York City, 25c.
(106) *Transactions,* Inst. of Min. Engrs., London, England, 6s.
(107) *Schweizerische Bauzeitung,* Zürich, Switzerland.
(109) *Journal,* Boston Soc. C. E., Boston, Mass., 50c.
(110) *Journal,* Am. Concrete Inst., Philadelphia, Pa., 50c.
(111) *Journal of Electricity,* San Francisco, Cal., 25c.
(113) *Proceedings,* Am. Wood Preservers' Assoc., Baltimore, Md.
(114) *Journal,* Institution of Municipal and County Engineers, London, England, 1s. 6d.
(115) *Journal,* Engrs.' Club of St. Louis, St. Louis, Mo., 35c.
(116) *Blast Furnace and Steel Plant,* Pittsburgh, Pa., 15c.
(117) *Engineering World,* Chicago, Ill.
(118) *Times Engineering Supplement,* London, England, 2d.
(119) *Landscape Architecture,* Harrisburg, Pa., 50c.
(120) *Automotive Industries,* New York City, 15c.

## LIST OF ARTICLES

### Bridges.

Stress Measurements on the Hell Gate Arch Bridge.* D. B. Steinman. (54) Vol. 82, 1918.
Obstruction of Bridge Piers to the Flow of Water.* Floyd A. Nagler. (54) Vol. 82, 1918.
The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City.* O. H. Ammann. (54) Vol. 82, 1918.
General Specifications for Steel Railway Bridges. (5) Dec., 1918.
Maintenance and Painting of Highway Bridges. Charles D. Snead. (Paper read before Road School, Univ. of Kentucky.) (86) Mar. 26; (96) Apr. 3.
Looking for Unsafe Conditions in Timber Bridges.* A. F. Robinson. (87) Apr.
Mechanical Features of Vertical-Lift Bridge.* J. A. L. Waddell. (55) Apr.
Reinforced-Concrete Lift-Span Towers for Highway Bridge.* F. H. Frankland. (13) Apr. 3.
Relieving Arches in Subway Distributes Stress to Piers.* (13) Apr. 3.
Canada's Longest Reinforced Concrete Trusses.* (96) Apr. 3.
The Michigan Avenue Improvement is the Most Important Addition to Chicago's Boulevard System.* Hugh E. Young. (117) Apr. 15.
Concrete Pile Trestle construction.* Albert M. Wolf. (117) Apr. 15.
The New Concrete Arch Bridge at Watertown, N. Y. (117) Apr. 15.
Dismantle Bridge Spans Carefully for Use Elsewhere.* (13) Apr. 17.
Timber Arch Bridge One Hundred Feet in Length.* D. R. Walkinshaw. (13) Apr. 17.
Highway Bridge Piles Concreted to Avoid Replacing.* F. E. Semon. (13) Apr. 17.
Standard Bridge Abutments on Canal Projects.* D. C. Willett. (13) Apr. 17.

### Electrical.

Carbon Brushes: Considered in Relation to the Design and Operation of Electrical Machinery.* P. Hunter-Brown. (77) Feb.
Reliable Performance of Large Turbines.* (116) Mar.
Commissioning Alternators. C. W. Marshall. (26) Mar. 21.
Continuous-Wave Land Radio Sets.* Paul T. Weeks and Donald G. Little. (27) Mar 29.
Compensated-Type Potential Regulators.* Arthur H. Ford and others. (27) Mar. 29.
Electrical Equipment of a Modern Shipyard.* A. Henderson. (73) Apr. 11.
Starting and Controlling Switchgear for Shipyard Machinery.* A. P. Pyne. (73) Apr. 11.
Electric Light and Power Circuits on Board Ship.* O. H. Kennedy. (73) Apr. 11.
Features of Muscle Shoals Station.* Edward R. Welles and W. A. Shoudy. (27) Apr. 12.
Automatic Induction Generator Plants.* E. A. Quinn. (111) Apr. 15.

* Illustrated.

**Electrical—(Continued).**

Pacific Coast Practice in Insulator Testing. (Report of Insulation Committee of N. E. L. A.) (111) Apr. 15.
Converting a Steam Plant to Stand-by Operation.* L. M. Klauber. (Paper read before N. E. L. A.) (111) Apr. 15.
Radio Telephony.* E. B. Craft and E. H. Colpitts. (19) Serial beginning Apr. 18.
Chart to Facilitate the Design of Lighting System.* (27) Apr. 19.
Bureau of Standards Studies Return Circuit Conditions in Milwaukee.* E. R. Shepard. (17) Apr. 19.
Modern Bus and Switch Structures.* C. D. Gray and M. M. Samuels. (27) Apr. 19.
Electrical Service at Great Seaboard Terminal.* (27) Apr. 19.
Electric Drive of the U. S. S. *New Mexico.** (27) Apr. 19.
Weighing High Temperatures in an Electric Balance.* J. M. Bird. (46) Apr. 26.
Flexible Distribution for Industrial Plants.* L. F. Leurey. (27) Apr. 26.
Interconnection Reduces Steam Reserve Necessary.* L. J. Moore. (27) Apr. 26.
Operation at Holtwood.* Charles H. Bromley. (64) Apr. 29.

**Marine.**

Reinforced Concrete Dock Gates.* (12) Mar. 21.
Submersible Salvage Pumps and Engines.* (12) Mar. 21.
Concrete Consistency Measured by New Device.* (Ships). Herbert A. Davis. (13) Mar. 27.
H. M. Seaplane-Carrying Ship *Argus*. (11) Serial beginning Mar. 28.
Luffing Cranes.* (117) Apr. 1.
Hudson River Shipyard Layout to Build Concrete Car Floats.* H. W. Eldridge. (13) Apr. 10.
Starting and Controlling Switchgear for Shipyard Machinery.* A. P. Pyne. (73) Apr. 11.
Electric Welding Applied to Shipbuilding.* J. H. Collie. (73) Apr. 11.
Electric Propulsion of Ships.* J. F. Nielson. (73) Apr. 11.
Electric Light and Power Circuits on Board Ship.* O. H. Kennedy. (73) Apr. 11.
The Searchlight Projector as Used in the Mercantile Marine.* R. C. Harris. (73) Apr. 11.
Electric Bonding on Board Ship. N. W. Prangnell. (73) Apr. 11.
Generating Machinery for Merchant Ships.* F. P. Fenton. (73) Apr. 11.
Electrical Equipment of a Modern Shipyard.* A. Henderson. (73) Apr. 11.
Modern Shipyard Cranes.* Claude M. Toplis. (73) Apr. 11.
Concreting Plant for Boston Dry Dock.* (86) Apr. 16.
Electric Drive of the U. S. S. *New Mexico.** (27) Apr. 19.
History and Properties of Light-Weight Aggregates (for Concrete Ships). (13) Apr. 24.
Great English Invention for Sweeping Up Moored Mines.* Halbert P. Gillette. (86) Apr. 30.

**Mechanical.**

Plant of the Seaboard By-Product Coke Company.* D. MacArthur. (83) Serial beginning Jan. 1.
Washing Light Oil Fractions from Coke Oven Gas.* F. D. Schreiber. (83) Jan. 1.
Chester Producer Fired By-Product Coke Ovens.* J. D. Shattuck. (83) Jan. 1.
Republic By Product Coke Plant at Youngstown.* (83) Jan. 1.
Insulation for By-Product Coke Ovens.* P. A. Boech. (83) Jan. 1.
Wood as a Fuel: Use for Industrial Purposes. (118) Mar.
Principles of Gas Purification and Purifier Design.* F. W. Steere. (83) Serial beginning Mar. 1.
Control of Water Gas Sets in Small Plants.* H. Von Vittinghoff. (From paper read before New England Assoc. of Gas Engrs.) (83) Serial beginning Mar. 1.
Vertical Retort Steaming Tests at Springfield.* L. J. Willien. (83) Mar. 1.
Dehydration of Various Tars: Gas Works Tar.* W. A. Twine. (Paper read before Midland Junior Gas Assoc.) (66) Mar. 4.
Structural Work in the Gas Works. (66) Mar. 11.
High Pressure Distribution Formulae. W. Marsh Hampton. (66) Mar. 11.
On Some Principles of Manufacturing Interchangeable Articles to Limit Gauges.* G. Gerald Stoney. (11) Mar. 21.
United States Nitrate Plant, No. 2, at Muscle Shoals, Ala.: The Boiler Room.* Charles H. Bromley. (64) Serial beginning Mar. 25.
Refrigerating Plant Data.* (64) Mar. 25.
The Lubrication of Motor Cars.* G. W. A. Brown. (Paper read before Inst. of Automobile Engrs. of Great Britain.) (120) Serial beginning Mar. 27.
Handling River Coal at Harrisburg. Henry J. Edsall. (45) Mar. 27.
Diesel Engines and the Merchant Marine. Bruce Lloyd and George A. Dow. (55) Apr.

* Illustrated.

**Mechanical—(Continued).**

The Large Steam Turbine.* J. F. Johnson. (55) Apr.
Refrigerating Plant Efficiency.* Victor J. Azbe. (55) Apr.
Heavy Field Piece with Mobile Mount.* C. L. McCrea. (55) Apr.
Lubrication of Air Compressors.* H. V. Conrad. (From a Report issued by Compressed Air Soc.) (55) Apr.; (45) Apr. 17.
The Design of Artillery Ammunition and Some Recent Developments at Frankford Arsenal.* J. Wallace Taylor. (2) Apr.
By-Product Plant of the Brier Hill Steel Company.* F. T. Moran. (83) Apr. 1.
The Operation of a Gearless Traction Elevator.* R. H. Whitehead. (64) Apr. 1.
The Largest Gas Utility Company in the World.* (83) Apr. 1.
Fusibility of Ash from Great Lakes and Mississippi Valley Coals.* W. A. Selvig and others. (Abstract of paper issued by U. S. Bureau of Mines.) (64) Apr. 1.
The Principles of Cooling of Airplane Engine Radiators. H. B. Irving. (120) Apr. 3.
Rolls for the Preparation of Coking Coals.* (45) Apr. 3.
Shop Routing System Reduces Handling Costs.* F. L. Prentiss. (20) Apr. 3.
The Working of Hydraulic Mains. E. W. Williams. (Paper read before Coke Oven Mgr's Assoc.) (57) Apr. 4.
Experiments with Bituminous Coal in the Manufacture of Water Gas.* R. G. Krumrey. (Paper read before Wisconsin Gas Assoc.) (24) Apr. 5.
Spring Suspension of Tractors.* P. M. Heldt. (120) Apr. 10.
Some Striking Features of a Large By-Product Coke Plant.* (45) Apr. 10.
Turning out 100 Tractors per Day.* P. M. Heldt. (120) Serial beginning Apr. 10.
Constructs Largest Gas Line in the United States. (13) Apr. 10.
Principles of Boiler Water Treatment. (*Bulletin* issued by U. S. Fuel Administration). (18) Apr. 12.
Gas Machine Factors Involved in the Manufacture of Carbureted Water Gas. R. B. Harper. (Paper read before Illinois Gas Assoc.) (24) Apr. 12.
Burning Lime in a Gas-Fired Continuous Kiln.* W. D. Mount. (105) Apr. 15.
High-Pressure Steel Economizers at Kansas City.* (64) Apr. 15.
Perfection in the Way of Uniform Pressure at the Consumer's Burner Can be Attained Only by High-Pressure Transmission. C. C. Boardman. (Paper read before Illinois Gas Assoc.) (83) Apr. 15; (24) Apr. 26.
The Use of Pulverized California Coal. Chas. H. Delany. (Paper read before N. E. L. A.) (111) Apr. 15.
Converting a Steam Plant to Stand-By Operation.* L. M. Klauber. (Paper read before N. E. L. A.) (111) Apr. 15.
Details of Operation of a Gas Producer Plant.* J. S. McClimon. (83) Apr. 15.
Treatment of Gas Works Waste.* L. R. Dutton. (Abstract of paper read before Am. Gas Assoc.) (83) Apr. 15.
Freezing Method for Testing Benzol in Paris Gas.* Emile St. Claire Deville. (From *Journal des Usines a Gaz.*) (83) Apr. 15.
How Scrubbers Retain Light Oils.* C. S. Heath. (Paper read before Illinois Gas Assoc.) (83) Apr. 15.
The Engine of the Side Car Motorcycle.* E. Caudwell. (Paper read before Inst. of Automobile Engrs.) (120) Serial beginning Apr. 17.
How 45-Ton Boilers Were Rolled 21 Miles Along Coast.* (13) Apr. 17.
The New Pittsburgh Station of the Bureau of Mines.* George W. Harris. (45) Serial beginning Apr. 17.
Fusibility of Ash from Coals Found in the Interior Province.* W. A. Selvig and others. (U. S. Bureau of Mines.) (45) Apr. 17; (64) Apr. 1.
The Manufacture of Small Chain.* E. R. Miner. (20) Apr. 17.
Increasing Capacity of Low-Pressure Mains by Admitting Gas at More than One Point.* A. C. Howard. (24) Apr. 19.
Is the Core of Stranded Wire Disproportionately Stressed. Paul A. B. Sahm. (17) Apr. 19.
The Clinker Grinder in Modern Boiler Practice.* Charles H. Bromley. (64) Apr. 22.
Proportioning Fuel Economizers.* A. B. Clark. (64) Apr. 22.
Comparison of the New A. S. M. E. Boiler Code and the Massachusetts Boiler Rules. (64) Apr. 22.
Pulverized Coal in Canadian Steel Plant.* C. F. Herington. (20) Apr. 24.
Tests of Colloidal Fuel.* (64) Apr. 29.

**Metallurgical.**

Leaching of Copper Ores at Bisbee, Arizona.* Joseph Irving. (74) Vol. 86, 1917.
The Wet Assay of Tin Concentrate.* H. W. Hutchin. (74) Vol. 26, 1917.
The Metallurgy of Electric Furnace Steel Processes.* L. B. Lindemuth. (Paper read before Assoc. of Iron and Steel Elec. Engrs.) (2) Dec., 1918.
Electrically Driven Plate Mills.* G. E. Stoltz. (2) Jan.

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* Illustrated.

**Metallurgical—(Continued).**

The Design of Heating Furnaces from a Practical Standpoint.* George J. Hagan. (58) Feb.
Cast-Steel Anchor Chain.* A. E. Crockett. (58) Feb.
Manganese Alloys in Open Hearth Practice. Samuel L. Hoyt. (116) Mar.
Novel Plate Turnover for Tandem Mill.* (116) Mar.
Investigation of Gases Occluded in Steel.* Thomas Baker. (Abstract of paper read before Faraday Soc.) (116) Mar.
Present American Acid Bessemer Process. Richard S. McCaffery. (From *Wisconsin Engineer.*) (116) Mar.
The Corrosion of Non-Ferrous Metals. Guy D. Bengough and O. F. Hudson. (Abstract of Report to Corrosion Comm. of Inst. of Metals.) (11) Serial beginning Mar. 21.
Electric Welding: Its Theory, Practice, Application and Economics. H. S. Marquand. (73) Serial beginning Mar. 21.
Reclaiming High-Speed Steel Scrap.* Edwin F. Cone. (20) Mar. 27.
Difficult Steel Casting. Robert Hadfield. (Abstract of paper read before Faraday Soc.) (20) Mar. 27.
Specifications for High Speed Steels. R. Poliakoff. (20) Mar. 27.
World's Largest Electric Steel Plant in Toronto.* George T. Clark and Frederick Phillips. (96) Mar. 27.
The Properties of Some Copper Alloys. W. Rosenhain. (Paper read before Inst. of Metals.) (11) Mar. 28.
Metallurgy of the Oklahoma-Kansas District. Robert W. Johnson and C. E. Heinz. (Abstracted from the *Joplin Globe.*) (16) Mar. 29.
Problem of Treating Impure Manganese Ores. Edmund Newton. (16) Mar. 29.
New Blast Furnace Gas Cleaning Outfit.* (116) Apr.
New Dry Cleaner for Blast Furnace Gas.* J. C. Barrett. (116) Apr.
Water Cooled Equipment for Open Hearths.* William C. Coffin. (116) Apr.
The Gas Welding of Thin Plates.* J. F. Springer. (25) Serial beginning Apr.
The Fatigue of Metals.* H. F. Moore. (2) Apr.
The Control of Methods and Processes.* H. L. Campbell. (Paper read before Steel Treating Research Soc.) (62) Apr.
Effects of Heat When Annealing Alloys.* H. C. H. Carpenter and L. Traverner. (62) Apr.
Observations on So-Called "Flakes" in Steel.* Haakon Styri. (105) Apr. 1.
Practical Considerations in Ammonia Leaching of Copper-Bearing Ores.* Lawrence Eddy. (105) Apr. 1.
Cleaning Furnace Gases without the Use of Water.* J. C. Barrett. (105) Apr. 1.
Composition and Characteristics of Lining Alloys. Alfred A. Greene. (Abstract of paper read before Purchasing Agents' Assoc. of St. Louis.) (20) Apr. 3; (17) Apr. 5.
Electric Welding and Its Applications. Walter Leonard Lorkin. (29) Apr. 4.
The Strength and Elasticity of Electrically Welded Joints. (11) Apr. 4.
The Micrography of Aluminium and Its Alloys.* D. Hanson and S. L. Archbutt. (Paper read before Inst. of Metals.) (11) Apr. 4.
The Influence of Cold-Rolling Upon the Mechanical Properties of Oxygen-Free Copper.* F. Johnson. (Paper read before Inst. of Metals.) (11) Apr. 4.
Unloading, Crushing and Screening at the Arthur Mill of the Utah Copper Company.* F. G. Janney. (103) Apr. 5.
Gray Iron Castings from Electric Furnace. George K. Elliott. (Abstract of paper read before Am. Electrochemical Soc.) (20) Apr. 10.
Calcining Plant at the Irthlingborough Mines of the Ebbu Vale Steel, Iron and Coal Co., Ltd. (22) Apr. 11.
Estimating Screen Efficiency.* W. O. Borcherdt. (16) Apr. 12.
The Electric Welding Load.* John Hood. (Paper read before N. E. L. A.) (111) Apr. 15.
Hardness Tests of Gun-Barrel Steel. William Kent Shepard. (72) Apr. 17.
The Greene Rolling Cylinder Arc Furnace.* (20) Apr. 17.
The Determination of Manganese: a Modification of Volhard's Method. W. C. Riddell. (U. S. Bureau of Mines.) (103) Apr. 19.
Hemet Magnesite.* F. B. Roney. (103) Apr. 19.
Iron-Ore Concentration on the Mesabi Range.* F. A. Kennedy. (16) Apr. 19.
Pulverized Coal in Canadian Steel Plant.* C. F. Herington. (20) Apr. 24.
The Vom Baur Electric Steel Furnace.* (20) Apr. 24.
Weighing High Temperatures in an Electric Balance.* J. M. Bird. (46) Apr. 26.

**Military.**

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# PAPERS AND DISCUSSIONS

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AMERICAN SOCIETY OF CIVIL ENGINEERS
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# PAPERS AND DISCUSSIONS

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## SEWAGE AND WASTES DISPOSAL FOR THE UNITED STATES ARMY

By Leonard S. Doten, M. Am. Soc. C. E.*

Presented December 18th, 1918.

Synopsis.

This paper presents a review of the work of the Sanitation Section of the Construction Division of the United States Army. The engineering problems are briefly discussed, and the designs of plants and equipment for the treatment of wastes and sewage in camps and cantonments of the United States Army are described. A comparison is made between the characteristics of municipal sewage and camp sewage, data being presented which show the exceptionally high concentration of camp sewage. Reference is made to special studies that were required to devise means to treat these wastes adequately.

The departure from previously recognized standard practice, in some instances, in the design of sewage treatment plants, and the reasons for it, are explained, and the results obtained at various camps are given.

Attention is called to the complexity of the sewage disposal problem, the field for careful research work in perfecting the processes

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Note.—Discussion on this paper in invited, and may be sent by mail to the Secretary. All discussion will be published in a subsequent number of *Proceedings*, and, when finally closed, the paper, with discussion in full, will be published in *Transactions*.

in use, and the necessity for the development of satisfactory plants at lower construction cost.

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Although the Construction Division (Cantonment Division) of the Army was organized only a very few weeks in advance of the beginning of construction work on the great military camps and cantonments in 1917, a great deal of study, nevertheless, was given to all problems dealing with sanitation. It was recognized from the first that the correct solution of the sanitary problems was extremely important. Many references were made to the unfortunate conditions as to sanitation which obtained during the Spanish-American War. The experience gained by the War Department in establishing and maintaining camps along the Mexican Border and in Mexico was of great value in the preparation of plans for the large camps constructed during 1917. As a result of this experience, each cantonment and officers' training camp was provided with a complete system of sewerage, including modern plumbing equipment. Authorization of complete water-carriage sewerage systems for the tent camps originally constructed for the National Guard was not secured until the beginning of the season of 1918. The systems are now complete.

In sanitation, as well as in problems of structural and other branches of engineering, the engineers of the Construction Division were required to devise plans and prepare general specifications which would meet all reasonable requirements and at the same time facilitate the execution of the work as much as possible, as speed in construction was of the utmost importance.

In the preliminary work it was soon found that it would be necessary to depart quite radically from many of the recognized standards of engineering practice. This will be shown later by illustrations of designs of structures and references to specifications.

The work with which the writer has been most intimately connected consisted in the preparation of standard designs and general specifications for water-carriage sewerage systems, sewage treatment plants, incinerators, transfer stations for camp wastes, drainage and anti-mosquito work, and the design of devices for reclaiming waste products having recoverable values.

In June and July, 1917, much study was given to the problem of the collection and disposal of garbage and other wastes at the sixteen

National Army Cantonments. As a result of this, it was decided to classify the wastes and separate the waste materials in such a manner as to secure the best possible returns from their sale. This was an important conservation measure. Favorable consideration was at first given to the establishment of reduction plants for the disposal of garbage. Later, however, it was found impracticable to adopt this method of disposal, because of the abnormally high cost of equipment and the long time for delivery, resulting from war conditions.

The scheme finally adopted consisted in collecting the garbage by the duplicate can system, collecting and transporting all valuable waste materials to a central transfer station, where they were delivered to the contractor, and he was required to haul all organic waste materials to a point sufficiently beyond the limits of the Government reservation to avoid any possibility of a nuisance being created, and to protect the health of the troops. Incinerators were built at each of the transfer stations, to be used in the destruction of such waste materials as had no commercial value, and also to be used in the case of an emergency when, for any reason, the contractor failed to remove the garbage promptly.

In some instances the contractors disposed of the garbage by means of reduction plants in large near-by municipalities; and in other cases this material was fed to hogs.

The waste materials were classified as follows: Garbage, paper, bottles, tin cans, bones, fats and grease, and manure.

The sale of these materials, rather than their destruction by incineration, has resulted in a large revenue to the Government, instead of a large outlay for equipment and fuel, which would have been required for disposal by incineration. For July, August, September, and October, the sales of garbage and other wastes included in the preceding classification amounted to $360 570. At this rate, the total revenue to the Government from this source for the year would be about $1 082 000.

The conditions at military camps are especially favorable for the use of the duplicate can system of collection, as there are so many units of approximately equal population. From the sanitary standpoint, this system also possesses a considerable advantage over the usual method of collection, due to the fact that the filled cans are transported directly from company kitchens to the transfer station, thus eliminating

the possibility of strewing waste materials on the grounds in the vicinity of camp buildings. The cans are thoroughly cleansed at the transfer station and are returned to the company kitchens at the time the filled cans are being collected.

The transfer stations (Plate II) are designed so as to provide the best possible facilities for the rapid transfer of wastes from Government vehicles to contractors' vehicles. Rooms are provided for the storage of non-perishable materials, such as paper, bottles, and tin cans, and a washing room is also provided for the cleansing of cans. The water for washing the cans is heated with pipe coils placed in an incinerator which is an adjunct to the transfer station.

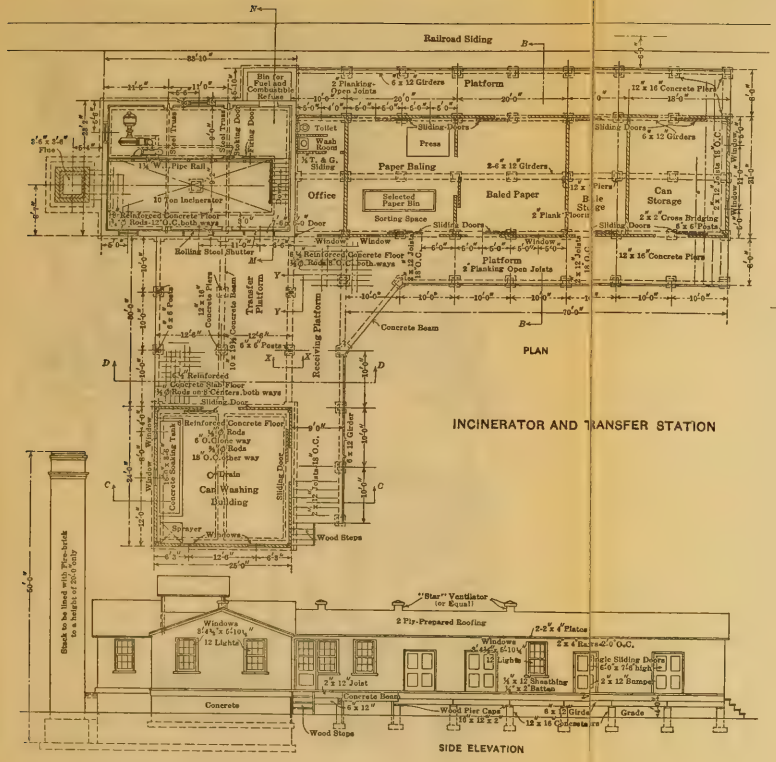
Special designs for can-washing equipment and incinerators have been developed by the Construction Division since some of the original plants were built. The cans are placed in long vats containing hot water, in which special cleansing compounds have been dissolved, and allowed to remain a sufficient time to loosen the organic and greasy material from the surfaces. They are then taken out of the vat and placed in a small chamber, constructed of light-weight steel plates, and subjected to a strong spray of hot water, both internally and externally, which thoroughly cleanses them. The waste products resulting from this process pass through a large grease-intercepting tank before being discharged into the sewerage system.

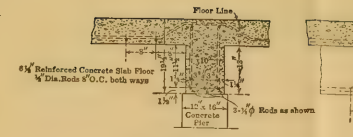
The can-washing equipment at the transfer stations (Fig. 1), as constructed in 1917, consisted of large circular tanks for hot water only. Later, at a few plants, mechanically-operated washing equipment was provided, but more recently the type of apparatus previously described has been used as a standard at all transfer stations.

During the season of 1918, special designs were prepared for incinerators which would meet all requirements for the incineration of both animal and vegetable wastes having no commercial value.

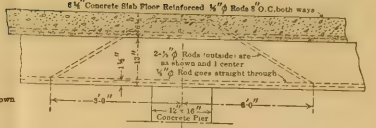
In determining the capacity of an incinerator for a camp, it is assumed that the quantity of material to be handled would be 1 ton per 1 000 men per day, and that 8 hours would be the operating period per day.

The designs provide for ample firing and combustion chambers; a grate surface for natural draft to burn 35 lb. per sq. ft. per hour, and for forced draft, 60 lb. per sq. ft. per hour; a drying hearth to facilitate the cremation and to prevent liquids from reaching the

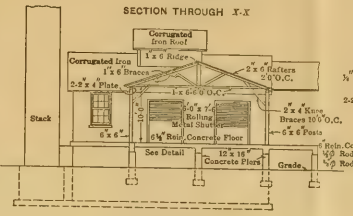


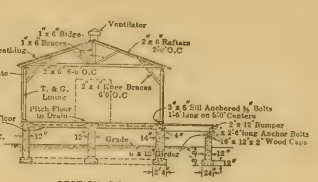

SECTION THROUGH *X-X*


6¾" Concrete Slab Floor Reinforced ⅜" ϕ Rods 8" O.C. both ways
2-⅞" ϕ Rods (outside) are as shown and 1 center ⅜" ϕ Rod goes straight through
3'-0"
12" x 16" Concrete Pier
6'-0"

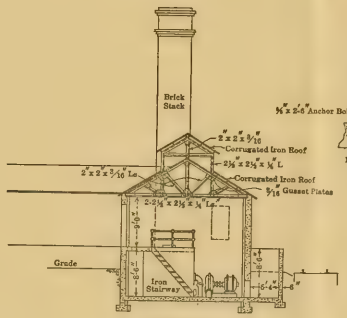
SECTION THROUGH *Y-Y*


Corrugated Iron Roof
Corrugated Iron 1 x 6 Braces
1 x 6 Ridge
2 x 6 Rafters 2'0" O.C.
2-2 x 4" Plate
1 x 6-6'0" O.C.
Stack
2 x 4" Knee Braces 10'0" O.C.
Rolling Metal Shutter
6" Reinf. Concrete Floor
6 x 6" Posts
See Detail
12 x 16" Concrete Piers
Grade
6" Rein. Concrete Floor
⅝" ϕ Rods 6'0" O.C.
½" ϕ Rods 15'0" O.C.

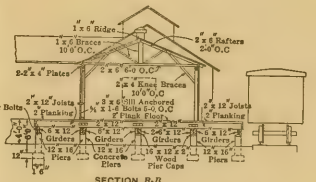
SECTION *D-D*


Ventilator
1 x 6 Ridge
1 x 6 Braces
2 x 6 Rafters 2'0" O.C.
½" Roof Sheathing
2-2 x 4" Plate
2 x 6 6'0" O.C.
2 x 4 Knee Braces 6'0" O.C.
T. & G. Lining
Pitch Floor to Drain
3" x 6" Sill Anchored ½" Bolts 1'6" long on 5'0" Centers
2" x 12" Bumper
2'6" long Anchor Bolts
16" x 12" x 2" Wood Caps
Grade
6 x 12" Girder
12"
24"

SECTION *C-C*


Brick Stack
2" x 2" x 9/16" Corrugated Iron Roof
2½" x 2½" x ¼" L
2" x 2" x 5/16" Le.
Corrugated Iron Roof
5/16" Gusset Plates
2-2¾" x 2½" x ¾" Le.
Grade
Iron Stairway

SECTION *M-N*


1 x 6 Ridge
1 x 6 Braces 10'0" O.C.
2 x 6 Rafters 2'0" O.C.
2-2" x 4" Plates
2 x 6 6'0" O.C.
2 x 4 Knee Braces 10'0" O.C.
¾" x 2'6" Anchor Bolts
2" x 12" Joists 2" Planking
3" x 6" Sill Anchored ½ x 1'6" Bolts 6'0" O.C.
2" Plank Floor
3" x 12" Joists 2" Planking
6 x 12" Girders
Concrete Piers
Wood Pier Caps

SECTION *B-B*

grates; dampers to control the draft; and ample stack area and height to prevent back-firing and produce an everage velocity of gases of approximately 20 ft. per sec. Plate III shows a 20-ton incinerator plant.

Although provisions were made for intercepting the grease from kitchen waste-water at the time the original cantonments were constructed, it was found, later, that the commercial type of trap which had been used was not effective, owing partly to faulty design and partly to limited capacity, and, early in 1918, it became evident that a more

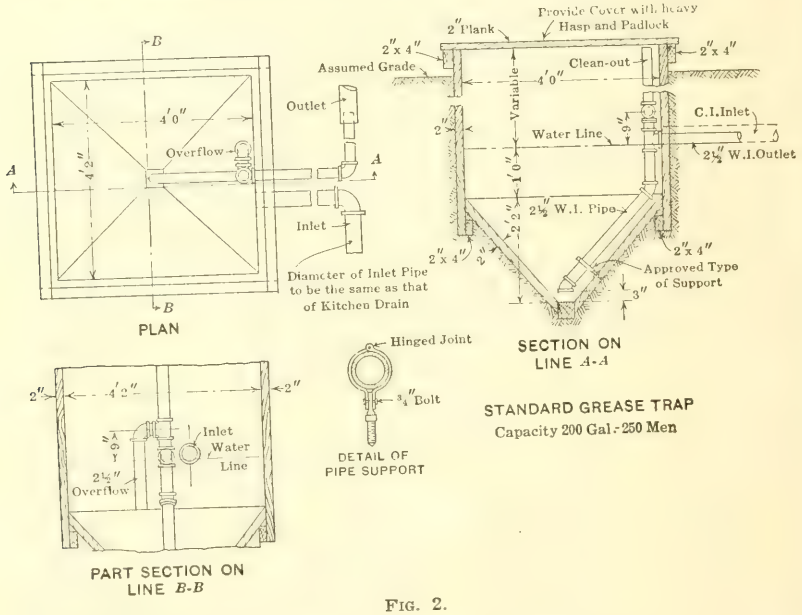
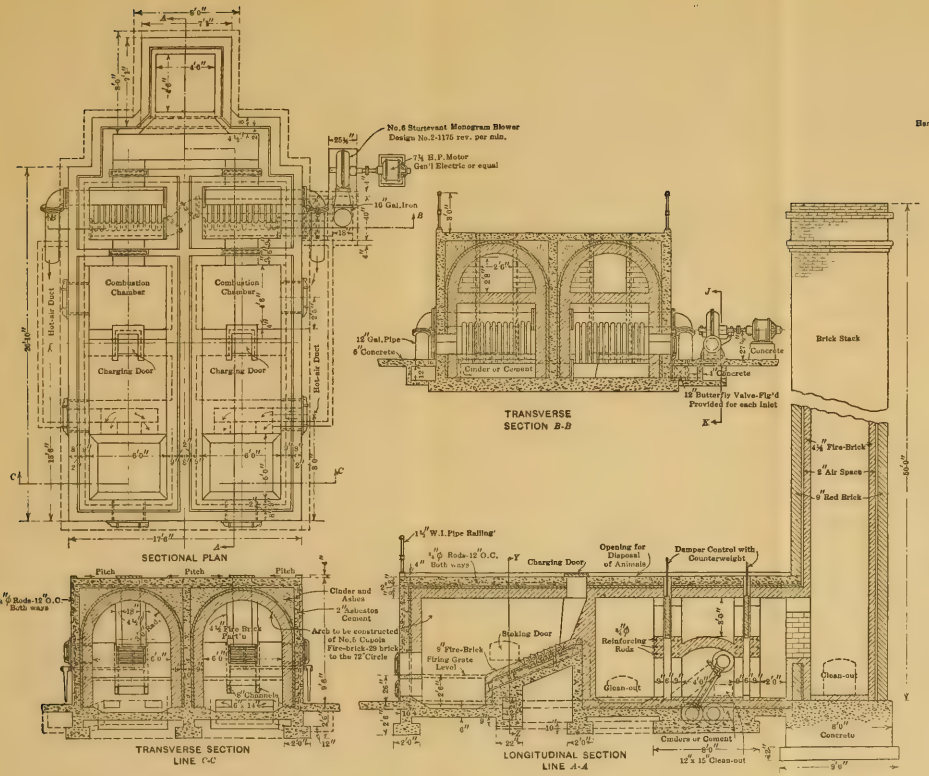



FIG. 2.

effective type should be used, in order to prevent the sewer pipe lines from being filled with grease deposits, and to relieve the excessive grease load on the sewage treatment plants. It was also recognized that the recovery of such large quantities of grease would result in a considerable revenue to the Government and would be in the interest of conservation.

Traps having a holding capacity of approximately $\frac{2}{3}$ gal. per capita were designed, and have been placed in nearly all the cantonments. (Fig. 2.) The special features of these traps are: the relatively large




20-TON INCINERATOR PLANT

area for the collection of grease; the steep-sided pyramidal, or conical, bottoms; and the small diameter of the eduction pipes which remove the settleable solids. The efficiency of these traps has been determined by several series of carefully made tests which show conclusively that the average efficiency under the usual operating conditions is at least 95%, and, in some instances, 99% has been recorded.

Grease recoveries by these traps range from 10 to 25 lb. per capita per year. The average is estimated to be between 12 and 14 lb. Thus it will be seen that the revenue obtained from this waste material alone is very high at present, owing to the high prices now being paid for this product. Rendering plants have been built at some of the camps for purifying the grease obtained from the traps, in order to secure a very much higher price for the product than would be obtainable if marketed in the crude state.

Numerous determinations of the grease content of the sewage have been made at the camps, and indicate that 150 parts per million is a fair average quantity. It will be noted that this is very greatly in excess of the quantities usually found in municipal domestic sewage, the average of the latter usually ranging between 20 and 30 parts per million. This is one of the most important characteristics of military camp sewage. The following are fair averages of some of the other constituents of camp sewage:

| | | | | |
|---|---|---|---|---|
| Total organic solids..... | 700 | parts | per | million |
| Total suspended organic solids..... | 464 | " | " | " |
| Free ammonia..... | 48 | " | " | " |
| Total organic nitrogen..... | 32 | " | " | " |

It will be seen, therefore, that the sewage is highly concentrated, and that the quantity of suspended organic matter is exceptionally high. The average quantity for nine American cities is 125 parts per million; for three English cities, 237; and for all cities, both foreign and American, it is 190. The conclusion, therefore, is that camp sewage contains about 3.7 times the average for nine American cities, 2.4 times the average for all cities, and nearly twice the average for English cities. The strength of the sewage is undoubtedly largely due to the relatively small per capita water consumption, certain waste products from kitchens, such as garbage and grease, and to the fact that the population is made up wholly of adults.

The sewage flow per capita per day ranges from approximately 35 to 60 gal. The fluctuations in the rate of flow, as shown by the graphs on the chart, Fig. 3, are much greater than in municipal systems.

When the general specifications for sewerage were prepared, it was anticipated that the maximum rate of flow from a divisional cantonment would be between 2½ and 3 times the average rate per 24 hours. Since that time, tests on several of the systems have shown that this estimate closely approximates the actual results. The maximum rate of flow occurs during shower-bath periods, and this continues for a period ranging from 40 to 60 min. at each unit. In the original speci-

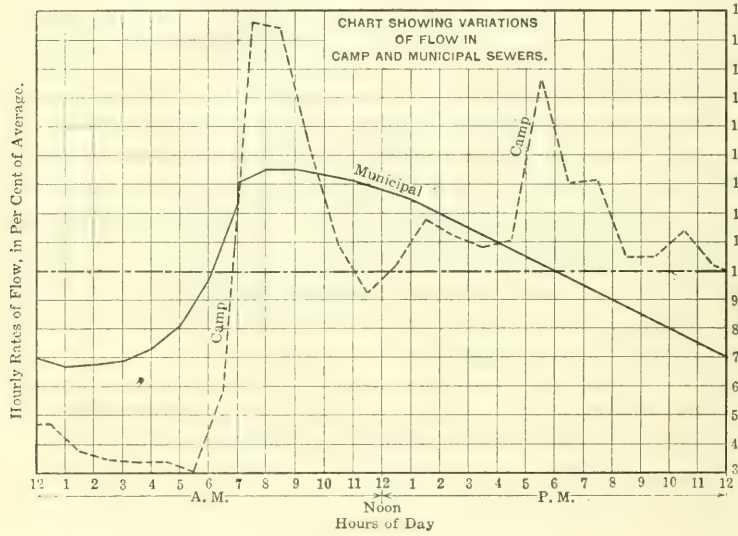



FIG. 3.

fications, certain requirements as to the capacities of the sewers were adopted. The assumption was made that it might be necessary to limit the use of shower baths in a divisional cantonment to one infantry brigade at a time, in order to avoid excessively high rates of flow, and consequently the construction of very large trunk and outfall sewers. As the specifications were drawn in advance of the selection of the sites for the cantonments, and, consequently, the exact location of the several units constituting a divisional cantonment had not been determined, it was impossible to calculate by a more exact method the necessary capacities of the sewer lines. Fortunately, however, the adoption of

this method resulted in a very satisfactory adjustment of sewer capacities.

As a result of the data which have since been accumulated, relative to the rates of flow in the several parts of cantonment systems, from tests made in the original sixteen cantonments, it has been possible during 1918 to check this method by a somewhat more scientific one involving as factors the maximum rates of discharge from individual units, the maximum length of time such discharges continue, and the distance that sewage would flow in that interval of time. This method of computing the sizes of sewers, in cantonments having approximately the straight-line type of layout, gives results which are materially lower than are obtained by using the former method. It is of less importance—although of considerable value—as a check on the original method in layouts approximating the horse-shoe type. In such cases, the concentration of flow at certain points is extremely high. In cantonments having a population of approximately 40 000 to 50 000, the maximum diameter for the outfall sewer is usually between 24 and 30 in.

The sewer connections to the lavatory buildings are 6 in. in diameter. In a few instances, the connections for kitchens have been 4 in. in diameter. The specifications adopted by the Construction Division contain a tabulation of minimum gradients, for sewers of different sizes, which will produce self-cleansing velocities. The calculations are based on a mean velocity of approximately $2\frac{1}{4}$ ft. per sec., with the sewer half full or full. All computations for capacities are based on sewers flowing approximately full during the highest rates of discharge.

The specifications require that the average distance between manholes shall be 350 ft. The manholes are of the simplest possible design, and are either square or round, depending on the kind of material used in construction. The sides are vertical, except where it is necessary to use standard cast-iron frames and covers. It has been the practice of the office to avoid, as far as practicable, the use of cast-iron frames and covers, both on account of the high cost of such material and the impracticability of using small covers on shallow manholes. By the adoption of wooden covers it is possible to have vertical walls, and thus improve the facilities for inspection and the introduction of sewer-cleaning apparatus. The wooden covers are very much cheaper than cast iron. A very important consideration, also, is the fact that it is necessary to lock the camp sewer manhole covers, in

order to prevent using them as receptacles for all kinds of refuse, such as old clothing, garbage, etc.

Vitrified clay sewer pipes, with the standard type of Portland cement joints, have been used almost wholly. In a few systems, concrete outfall sewer pipe lines have been constructed.

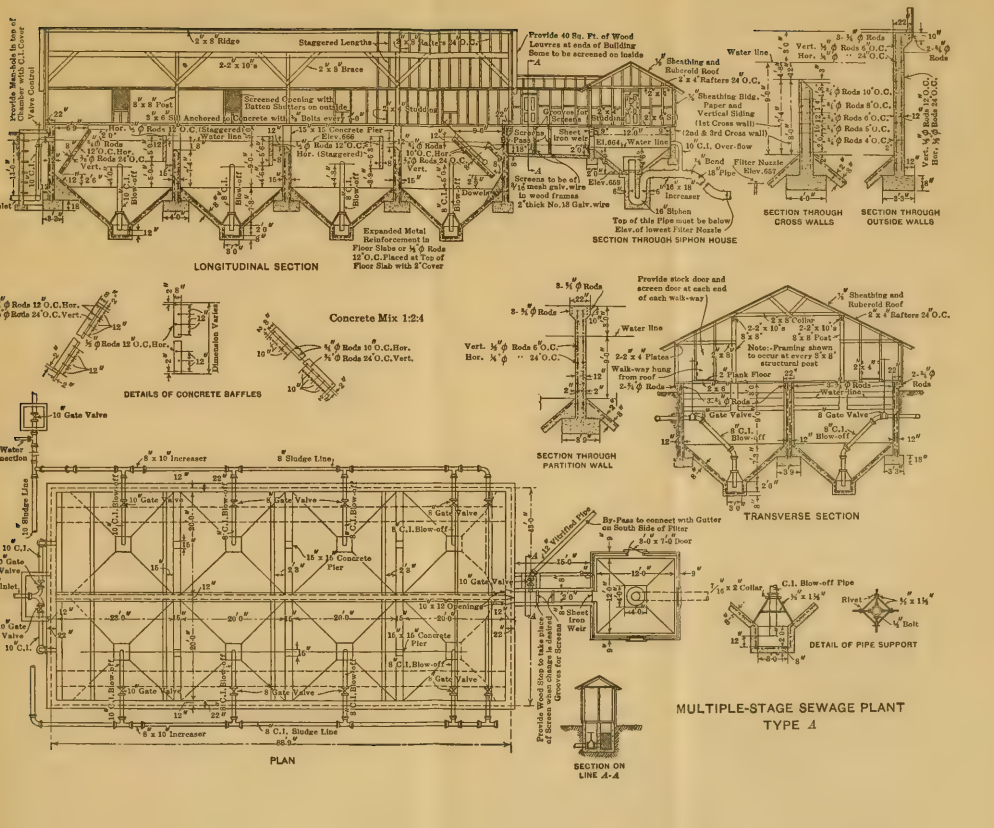
### Sewage Treatment Plants.

Excepting in a few instances, where the type of sewage treatment works was pre-determined by soil characteristics or peculiarities of local practice favored by State Boards of Health, the standard type of tanks and filters adopted by the Construction Division has generally been used. Different types of tanks were very carefully considered before standards were adopted, taking into account the peculiar characteristics of the sewage, so far as known at that time, the necessity for rapid construction, and the comparative cost of different designs. The standard tanks are designed on the simplest possible lines, in order to facilitate construction and reduce the cost to a minimum. They are shown on Plate IV, and are of a multiple-compartment horizontal-flow type, provided with baffles and cross-walls, or weirs, in such a way as to facilitate sedimentation and the withdrawal of sludge. The bottoms of compartments are pyramidal.

In operation, the tanks are comparatively easy to control, especially with domestic sewage of average quality. In this respect they have a marked advantage over the older types.

Among other types considered for use at cantonments was the Imhoff tank, but the principal reasons for not adopting it were: (1) the high cost of construction, estimates showing that their average cost would be approximately three times as much as for the single-story tank; (2) the time required for construction would be at least twice as great as for the latter; and, furthermore, it would be less well adapted for treating the fresh uncomminuted camp sewage (Fig. 4). In the light of more recent developments, it is fortunate, for another reason, that the Imhoff tank was not adopted, namely, the difficulty of using a short-period, sedimentation tank which is incapable of protecting filters against excessive quantities of grease carried in the sewage.

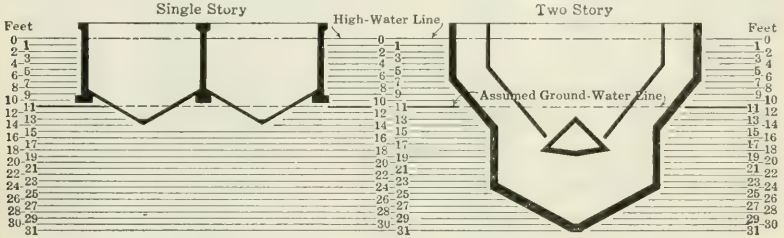
The practice of the Construction Division has been to build treatment works only at camps where it was impracticable to construct an outfall sewer to connect with a city system, or to dispose of the sewage


LONGITUDINAL SECTION
SECTION THROUGH SIPHON HOUSE
SECTION THROUGH CROSS WALLS
SECTION THROUGH OUTSIDE WALLS
DETAILS OF CONCRETE BAFFLES
Concrete Mix 1:2:4
SECTION THROUGH PARTITION WALL
TRANSVERSE SECTION
PLAN
SECTION ON LINE A-A
DETAIL OF PIPE SUPPORT
MULTIPLE-STAGE SEWAGE PLANT
TYPE A

by discharging it into a large body of water, or a river where the dilution factor would be satisfactory.

In most cases, the treatment works consist of sewage tanks and chlorinating equipment only. In comparatively few cases has it been necessary to put in secondary treatment works consisting of trickling filters and secondary sedimentation tanks.

The trickling filter, Fig. 5, owing to its large unit capacity, simplicity of operation, and low cost, was adopted as the best means for secondary treatment. The designs for these filters differ in several important details from the usual municipal engineering practice. Deep, expensive excavations were avoided wherever practicable, advantage being taken of the conformation of the site. This was also true of the retaining walls, which were omitted wherever possible, terminating the filtering material with steep slopes.




CROSS-SECTIONS OF SEWAGE TANKS OF EQUAL CAPACITY SHOWING THE RELATIVELY GREAT DEPTH OF A 2-STORY TYPE AS COMPARED TO THE STANDARD TYPE. THE COST OF THE FORMER TANK IS GREATLY INCREASED ON ACCOUNT OF DEPTH BELOW GROUND-WATER LINE.

FIG. 4.

The filter has an undulating floor, the distributor pipes being placed on the summits and pipe-covered gutters in the depressions. Thus the expensive system of under-drains, which is usually an important feature in plants for municipalities, was eliminated. The inverts of the drains and gutters are in a plane parallel to the plane passing through the spray nozzles. This plane has an inclination approximately equal to the hydraulic gradient of the distributing system during the average rate of discharge from the nozzles.

The filtering material consists of hard, durable, crushed rock or slag, the pieces of which will pass a screen of $2\frac{1}{2}$-in. openings and be retained on a screen having $1\frac{1}{2}$-in. openings. Relatively coarse rock, having little variation in size of pieces, is favored, as such material has large voids, which are not completely filled with accumulations or

films, and consequently admit of a free circulation of air. The first filters constructed were 6 ft. deep. In a few plants for hospitals, 8-ft. filters were used. The present standard depth for trickling filters is 5 ft.

### Dosing or Siphon Chambers.

The writer's experience and observations led him to devote a great deal of attention to the design of siphon chambers, with a view to securing the highest possible efficiency in the operation of trickling filters. A radical change has been made in the dosing period, reducing it from 4 or 5 min. to a maximum of 1½ min. for filters of all depths. Filters not more than 5 ft. in depth, when dosed in this manner, will yield a uniformly stable effluent, which is generally very low in turbidity. The degree of nitrification and oxidation which takes place in such a filter is equal to that obtained from deeper filters, as is illustrated by the following figures taken from a recent report on a series of tests on the Fort Myer, Va., filter. In this report, a comparison is made between the results obtained from the experimental trickling filter at Boston in 1907, and those from the Fort Myer filter. The tank effluent, in so far as the organic nitrogen and free ammonia were factors, was practically the same in the two cases. Expressed in parts per million, the filter effluent from the Boston plant contained organic nitrogen, 3.4; free ammonia, 12.0; nitrites, 0.8; nitrates, 5.3. The Fort Myer filter effluent contained: organic nitrogen, 0.7; free ammonia, 1.8; nitrites, 0.4; nitrates, 25.7. The Fort Myer effluent averaged in dissolved oxygen 42% of saturation. This filter, in the same series of tests, gave an average reduction of 95% in total count of bacteria and 92% reduction in *B. Coli.* Numerous tests, made during the past 8 months, on the effluent from this filter, have shown 100% stability at all times.

During the season of 1917, all sewage treatment plants were designed by the supervising engineers in the field, following the requirements of the general specifications and standards which had been adopted by the Construction Division. During the season of 1918, however, the engineering force of the Sanitation Section of the office has been largely augmented, and all designs for treatment works have been prepared in the Washington office. This has been found to be a more satisfactory arrangement than that of the previous season.

The following assumptions are made in the design of all sewage treatment plants: For temporary camps or cantonments, average daily

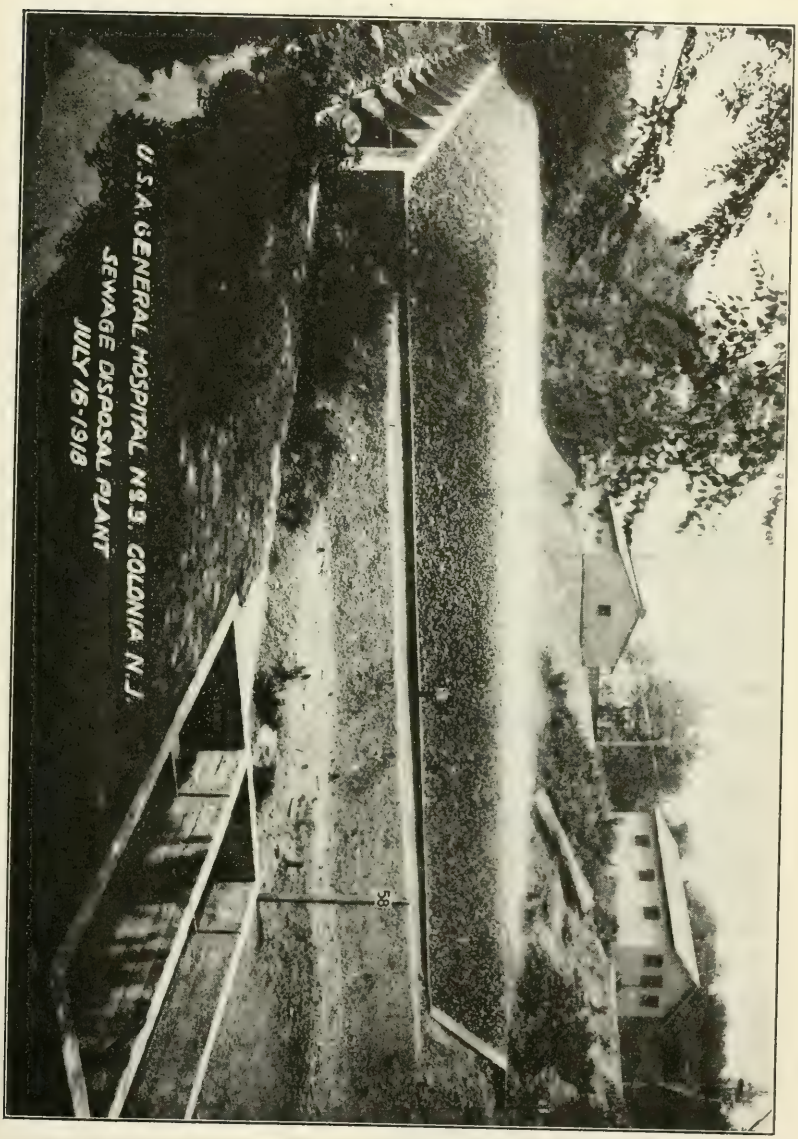



FIG. 5.—SEWAGE DISPOSAL PLANT AT U. S. A. GENERAL HOSPITAL NO. 3, AT COLONIA, N. J.

per capita flow of sewage, 60 gal.; hospital plants, 150 gal. per bed per day, and 60 gal. per attendant per day; average detention period in tanks, 6 hours, based on net capacity of tank, making a certain allowance for sludge capacity; maximum dosing period during highest rates of flow, 1½ min.; filter capacity, 30 000 population per acre, with 5-ft. depth.

Up to the close of 1918, the Construction Division has built 150 tanks of standard design and they have a total holding capacity of 20 000 000 gal. These plants are distributed throughout all parts of the United States. Comparatively few filters have been constructed, the total number being only 19, having a total area of 447 000 sq. ft.

The writer's experience leads to certain conclusions relative to sewage treatment plants and processes, which are summarized as follows:

Sewage contains both acid and base-forming constituents. If the base-forming elements predominate, the decomposition of sludge and scum will be rapid. If, on the other hand, the acid products of decomposition are not promptly neutralized, bacterial decomposition will be greatly retarded.

If the water portion of the sewage is high in alkalinity, the bacterial action will be vigorous, and the digestive capacity of a tank correspondingly increased. Co-ordination of certain observed facts relative to the performance of tanks in widely separated parts of the country has confirmed this conclusion.

The color of sludge alone is not a true indicator of thoroughness of digestion, as the sludge in an Imhoff tank may be blackened by the presence of iron sulphide, one of the products of decomposition, and still be incompletely digested. It is true, however, that well-digested sludge is either dark brown or black. Furthermore, the so-called "tarry" odor is not an essential characteristic of thoroughly digested sludge, as the writer has examined many samples which not only did not have an odor of this kind, but were practically odorless, and dried very rapidly, even under adverse conditions.

The effluent from a Construction Division type of tank, when functioning normally, is superior to that of a plain sedimentation tank, due to the fact that the very finely divided matter borne in suspension is partly mineralized.

The capacity of a trickling filter does not vary directly with the volume of filtering material, a 5-ft. filter giving as good results as a

deeper one. The average rate of dosing for filters of all depths should not exceed 2 000 000 gal. per acre per day, if a high degree of purification is desired. The short dosing period is of more importance than perfect distribution.

The humus discharged from properly functioning trickling filters should not create an objectionable condition due to putrefaction. The putrescible character of the effluents from some deep trickling filters, and also the humus held in suspension, is due either to an inferior quality of tank effluent or to improper dosing. If the flow from spray nozzles continues too long, the entire depth of filtering material will be drenched, with the result that insufficient time will be given for the thorough oxidation and nitrification of the organic matter. The flow from under-drains should be maintained at as uniform a rate as possible.

Treatment by intermittent sand filters, even in localities where the soil is of exceptionally good quality for the purpose, has not been as satisfactory as anticipated, owing to the unusually high grease content in the sewage. It has been necessary, consequently, in certain instances, to put in tanks for the preliminary treatment of the sewage before discharging it on the sand beds. Furthermore, such plants (intermittent sand filters) are usually higher in cost of construction, and considerably more expensive to operate, than those of the standard type.

The wide variations in rates of flow at camp sewage treatment plants, the extremely high suspended organic content of the sewage, and the inhibiting influence on bacterial development resulting from the excessively large quantities of grease, are important factors in determining the load which is borne by the camp sewage tanks. Statistics fail to show that there has ever been any instance where these adverse fundamental factors were so great. This is a fact that should not be overlooked in assigning tanks of this type to their proper place in the sanitary engineering practice of the future.

It is realized that the problem of sewage disposal is very complex, due to the great variety and combinations of waste matter which constitute sewage. There is an ample field for research work along several lines, in order to perfect the processes now in use, and to develop, if possible, plants which will give satisfactory results at lower construction cost. The economic factor should not be overlooked, as it has a most direct influence in determining the progress in this field of sanitary engineering.

AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

# PAPERS AND DISCUSSIONS

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## THE PROPOSED NEW YORK AND NEW JERSEY VEHICULAR TUNNEL

An Informal Discussion at a Meeting of the Society, March 19th, 1919.

By Messrs. Edward A. Byrne, John F. O'Rourke, Paul G. Brown, J. V. Davies, James Forgie, W. C. Parmley, T. Kennard Thomson, F. Lavis, Calvin Tomkins, and Amos Schaeffer.

Mr. Byrne.

Edward A. Byrne, M. Am. Soc. C. E.*—The purpose of this discussion is to call attention to some of the reasons for constructing a vehicular tunnel to connect New York and New Jersey, and to discuss the merits of the various types of tunnels proposed.

Before proceeding, however, it might be well to state that, although the construction of a bridge across the Hudson River had been agitated for many years, it was not until 1906 that any official action was taken by the States of New York and New Jersey. In that year both States appointed Bridge Commissions to report on the advisability of building a bridge across this river. In 1913 additional powers were granted to the New York Commission by the Legislature, which enabled it to direct its attention to tunnel construction, the New Jersey Commission having received like powers from the Legislature of that State.

In February, 1913, Messrs. Jacobs and Davies reported to the Commissions that a tunnel was entirely feasible, and recommended two tubes, to be driven by the shield method—one for east-bound traffic and one for west-bound traffic—each with a roadway having a width of 17 ft. and head-room of about 12 ft. 6 in., the inner diameter of the tunnels

* New York City.

Mr. Byrne.

to be 22 ft. and the outer diameter 25 ft. This is shown by Fig. 1. The New Jersey terminal was to be on 12th Street, Jersey City, and the New York terminal on Canal Street, as shown by the plan and profile, Fig. 2. For lining, cast-iron was recommended, with a concrete facing. In 1910, this firm had prepared a plan for a two-level tunnel, Fig. 3. The lower level provided a roadway 16 ft. wide, with 9 ft. head-room; the upper roadway was to be 18 ft. 6 in. wide, with head-room of 10 ft. 6 in. at the curb and 12 ft. 3 in. at the center. On this upper level there were two footwalks for pedestrian traffic. It was contemplated that fast-moving automobiles would be placed on the lower level and all other traffic on the upper level.

The study for the arrangement of a roadway tunnel crossing beneath the Hudson River by Messrs. Jacobs and Davies, is based on the assumption that it is not probable that any large amount of pedestrian traffic would be likely to pass through such a tunnel, as the distance from shore to shore is about a mile at the region of Cortlandt Street, New York, and about $\frac{3}{4}$ mile at 59th Street. Hence, as much space as possible has been devoted to vehicular traffic, for which separate accommodation has been provided for "Fast" and "Slow", the fast being confined to the lower, and the slow to the upper, roadway.

Air ducts have been shown, to permit of mechanical ventilation.

Ample head-room is afforded for each type of traffic. For example: the highest slow-moving truck is about 10 ft. 3 in. high, and the head-room provided for vehicles of this class is 12 ft. 3 in.

The height of the highest limousine automobile is 7 ft. 10 in., and the headroom provided for fast vehicles is 9 ft. 0 in.

In July, 1916, the Public Service Corporation of New Jersey selected a Board of Engineers to report on the design and feasibility of a vehicular tunnel under the Hudson River. This Board consisted of W. H. Burr, Ralph Modjeski, and D. B. Moran, Members, Am. Soc. C. E., and, in January, 1917, it reported in favor of the construction of a tunnel by the trench method. The section in the river was to be of reinforced concrete resting on timber piles. It was to be, generally speaking, elliptical in section, the inner major axis being 28 ft. 4 in. and the outer axis 36 ft. 5 in. The over-all distance from top of piles to roof was 28 ft. 10 in. One roadway, 17 ft. wide with head-room of 13 ft., and two footwalks, one 5 ft. 6 in. and one 3 ft. 6 in. wide, were to be provided.

In September, 1917, Gen. George W. Goethals, U. S. A., M. Am. Soc. C. E., was retained by the Joint Commission to report on the best type of tunnel to be built. In November of that year he recommended the construction of a single tunnel with two levels, to be constructed by the shield method, and pre-cast concrete blocks were to be used in place of cast-iron with concrete lining. No change in location was recommended.

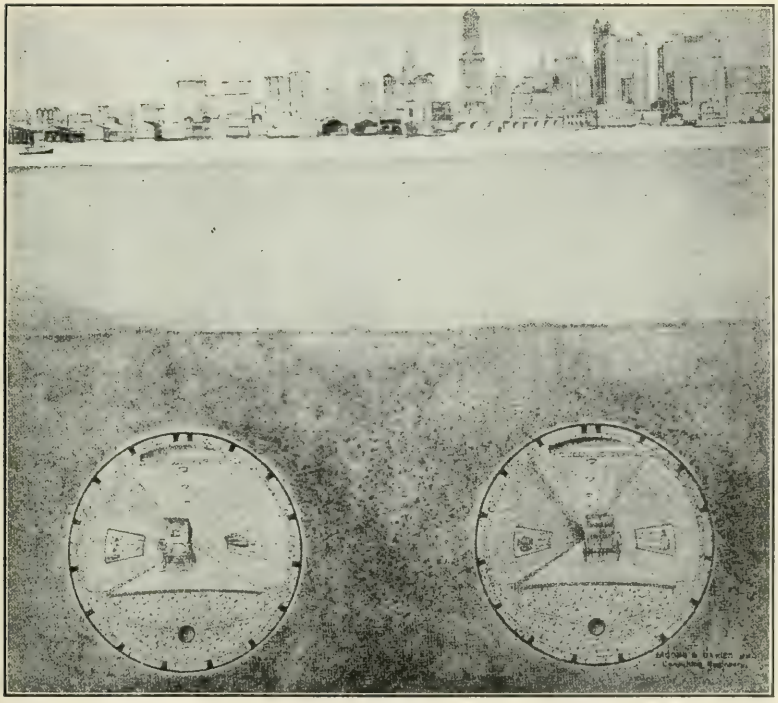
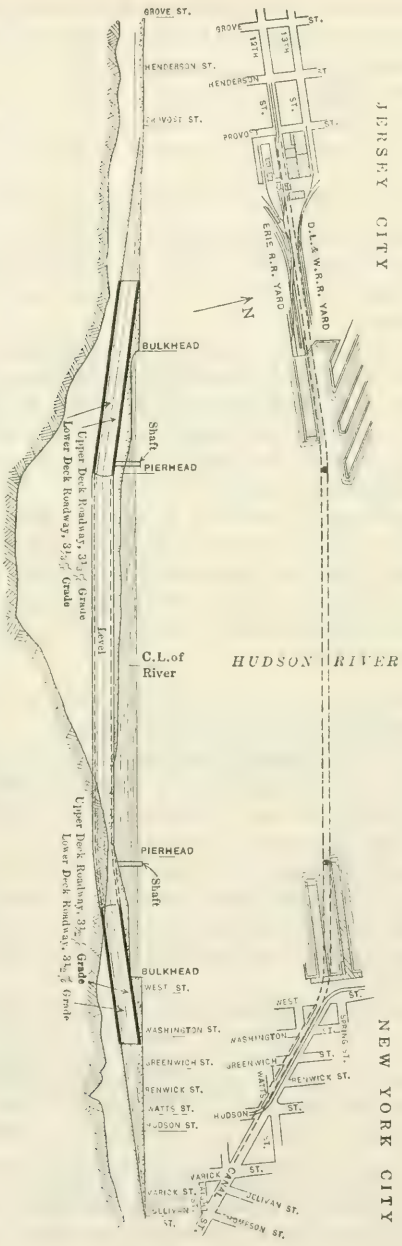


Fig 1.—Cross-Sections of One-Level, Two-Way Each, Vehicular Tunnels.

Mr. Byrne.




PLAN AND PROFILE OF PROPOSED NEW YORK AND NEW JERSEY VEHICULAR TUNNEL.

FIG. 2.

Mr. Byrne.

The following are the estimates of cost of the three tunnels:

| | |
|---|---|
| 1913—Jacobs and Davies, for two tubes, "pre war estimate," | $11 000 000 |
| 1917—Burr, Modjeski, Moran, one tube, "normal prices," | 6 899 000 |
| 1917—Gen. Goethals, one tube, "war prices," | 12 000 000 |

Reasons for the Construction of a Vehicular Tunnel:

1.—Reduce vehicular congestion at the ferries.

2.—Prevent recurrence of possible coal and food famines, due to interruption of navigation on account of weather or labor troubles.

3.—Free part of river front now occupied by railroad companies for car-float and freight-lighter deliveries, by having freight delivered to New Jersey and hauled by trucks to New York, and *vice versa* for freight from New York. New Jersey has plenty of room for freight terminal expansion, but New York has practically none.

4.—Reduce cost of handling freight at New York by eliminating great trucking waste due to delay in receiving and delivering freight to railroad terminals. It will save the cost of rehandling at New York terminal. The expense of operating through the tunnel will more than offset lighterage and terminal charges in New York.

The construction of the tunnel has been recommended by all the substantial organizations of New York City.

The New York Assembly has passed a bill authorizing the New York Commission to enter into a contract with the State of New Jersey for its construction. This contract, to become effective, must be ratified by the United States Congress.

The Assembly bill carries an appropriation of $1 000 000, and, if it becomes a law, practically binds the State of New York to an expenditure not to exceed $6 000 000 as its share for the tunnel.

New Jersey has enacted legislation to provide a sum equal to that of New York.

The estimated annual capacities of the three designs under consideration are:

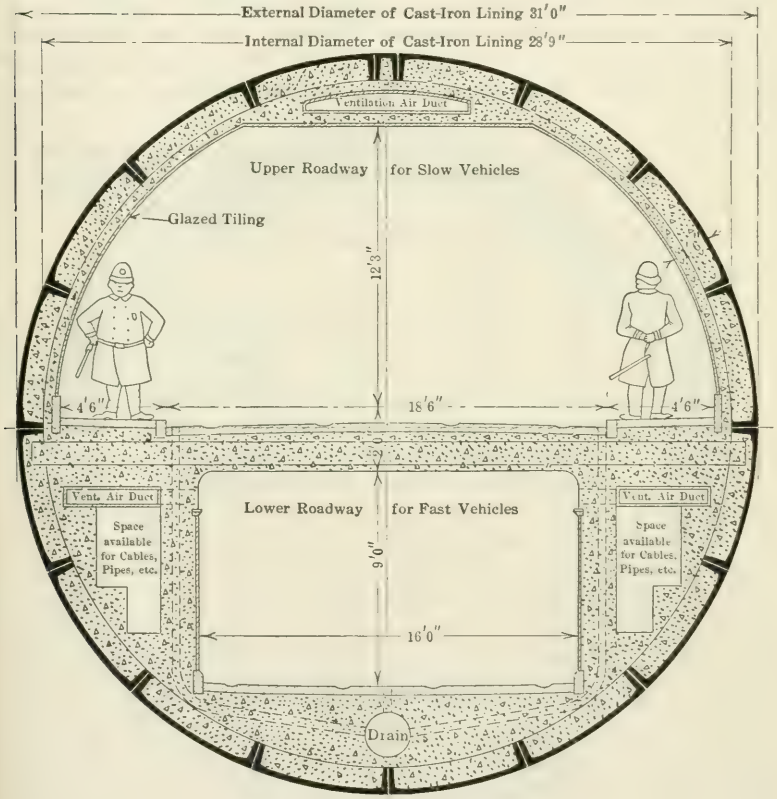
| | | |
|---|---|---|
| Jacobs and Davies | 5 000 000 | vehicles. |
| Burr, Modjeski, Moran | 15 417 600 | " |
| Gen. Goethals | 36 500 000 | " |

Messrs. Jacobs and Davies present no details as to what speed and spacing were assumed. Messrs. Burr, Modjeski, and Moran assumed 10 miles per hour and 60 ft. spacing, from center to center of vehicles.

Mr. Byrne.

In calculating the capacity of Gen. Goethals' plan, it was estimated that 100 000 vehicles in both directions could pass for 24 hours, as follows:

| | Speed, in miles per hour. | Distance, center to center. | Number of vehicles per hour. |
|---|---|---|---|
| Horse-drawn vehicles | 3 | 50 ft. | 300 |
| Slow motor vehicles | 9 | 60 " | 800 |
| Fast motor vehicles | 15 | 80 " | 990 |
| Estimated hourly capacity | | | 2 090 |
| Total estimated capacity, in both directions, for 24 hours | | | 100 320 |




ROADWAY TUNNEL ACROSS HUDSON RIVER.
STUDY FOR SUGGESTED ARRANGEMENT
OF ROADWAYS, ETC. IN TUNNEL
31′0″ EXTERNAL DIAMETER.
Nov. 18, 1910

FIG. 3.

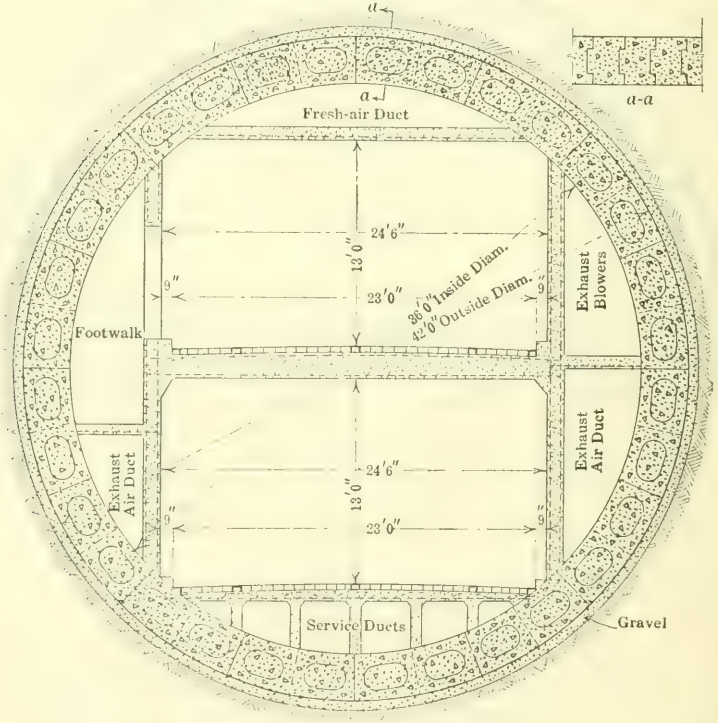
Mr. Byrne.

Applying Gen. Goethals' estimate to the design of Messrs. Burr, Modjeski, and Moran, and bearing in mind that the capacity for a single line of traffic must be controlled by the speed of the slowest moving vehicle, this tunnel would have a capacity of 14 000 vehicles in both directions per day, or 4 646 000 per year.

Applying Gen. Goethals' estimate to the plan of Messrs. Jacobs and Davies, it is estimated that 52 800 vehicles can be passed in both directions in 24 hours, or 19 272 000 annually.

The five ferries, at Cortlandt, Barclay, Chambers, Desbrosses and Christopher Streets, from which this tunnel would tend to take traffic, carry about 10 000 vehicles daily. It is estimated that the tunnel would attract at least 60% of this ferry traffic, or 6 000 vehicles daily.

The Delaware, Lackawanna and Western, Erie, and Pennsylvania Railroads carry across the Hudson daily 1 500 freight cars in each direction, a total of 3 000 cars daily. Assuming that these cars con-




TYPICAL SECTION
NEW YORK AND NEW JERSEY VEHICULAR TUNNEL
CROSS-SECTION OF A TWO-LEVEL, THREE-WAY EACH,
VEHICULAR TUNNEL
FIG. 4.

tain 20 tons each, 60 000 tons are carried daily. If one-half of this tonnage is hauled through this tunnel on trucks, with an average capacity of 4 tons each, it will require 7 500 trucks to do the work. Adding the traffic directed from the ferries, there results a daily total of 13 500 vehicles, or 4 500 000 annually (333⅓ days per year). Mr. Byrne.

Pleasure automobiles, which would be diverted from ferries north of Christopher Street, have not been taken into account in this calculation. Assuming 1 500 per day as a fair average, the daily total would be 15 000 vehicles, or practically the same number as Manhattan Bridge is now carrying.

This estimate is very conservative, and, if the increased traffic on the East River Bridges for the past few years is any criterion, we may confidently look forward to an increase in traffic of 100% in 10 years in this tunnel.

Table 1 is a statement of the vehicular traffic over the four East River Bridges, taken from the records of the Department of Plant and Structures, and is instructive and worthy of much consideration in determining the type of tunnel for the needs of the estimated traffic to be accommodated.

EAST RIVER BRIDGES. GENERAL STATISTICS.

| | Opened. | Length. | Roadways. | Width. |
|---|---|---|---|---|
| Brooklyn Bridge..... | 1883 | 6 016 ft. | 2 | 16 ft. 9 in. each. |
| Williamsburg Bridge.. | 1903 | 7 308 " | 2 | 20 ft. 0 in. " |
| Manhattan Bridge.... | 1909 | 6 855 " | 1 | 35 ft. 0 in. |
| Queensboro' Bridge... | 1909 | 7 449 " | 1 | 52 ft. 0 in. |

In designing any new bridge similar to these structures, no one would think of taking the roadway widths of the Brooklyn or Williamsburg Bridges as adequate for present-day requirements.

The Manhattan Bridge roadway is 35 ft. wide, sufficient to pass two lines of traffic in each direction. In order to care for the morning and evening rush-hour traffic on this bridge, horse-drawn vehicles are prohibited from crossing from Brooklyn in the evening period and from Manhattan in the morning period. During both these periods this traffic is diverted to Brooklyn Bridge, making it possible to accommodate three lines on Manhattan Bridge from Brooklyn in the morning rush and to Brooklyn in the evening rush.

The Police Department, in order to increase the capacity of Fifth Avenue, removed the isles of safety at 42d Street and at several streets north of that intersection. Formerly, only three lines of vehicles could be operated in each direction. By the removal of these obstructions four lines are now accommodated in the direction of the morning and evening rush periods, and two lines in the opposite direction. The Police Department reports that 18 800 vehicles pass 42d Street and Fifth Avenue in 10 hours.

Mr. Byrne.

TABLE 1.—Daily Vehicular Traffic

| Bridge. | October 24th, 1912. | | | October 30th, 1913. | | | November 5th, 1914. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Horse-drawn. | Motor-drawn. | Total. | Horse-drawn. | Motor-drawn. | Total. | Horse-drawn. | Motor-drawn. | Total. |
| Brooklyn..... | 3 114 | 799 | 3 913 | 2 909 | 1 305 | 4 214 | 2 643 | 1 340 | 3 983 |
| Manhattan..... | 3 074 | 1 749 | 4 823 | 3 723 | 2 323 | 6 046 | 4 005 | 3 611 | 7 616 |
| Williamsburg..... | 4 351 | 1 573 | 5 924 | 5 093 | 2 324 | 7 417 | 4 901 | 2 290 | 7 191 |
| Queensboro'..... | 1 354 | 2 290 | 3 644 | 2 036 | 4 538 | 6 574 | 2 002 | 5 205 | 7 207 |
| Totals..... | 11 893 | 6 411 | 18 304 | 13 761 | 10 590 | 24 251 | 13 551 | 12 446 | 25 997 |

Four East River Bridges:

1912, Total number of vehicles, 18 304; 1919, 46 305 vehicles. Increase, 150 per cent.

1912, 11 893 were horse-drawn; 1919, 9 750 were horse-drawn. Decrease, 18 per cent.

1912, 6 411 were motor-drawn; 1919, 36 555 were motor-drawn. Increase, 470 per cent.

1912, Manhattan Bridge, total vehicles, 4 823; in 1919, 14 613. Increase, 200 per cent.

Estimated tunnel traffic, first year after opening, 15 000 vehicles daily, with estimated increase of 100% in 10 years.

The four East River bridges have been the means of the discontinuance of seven ferries (Wall Street, Catharine Street, Roosevelt Street, Grand Street, Houston Street, 23d Street to Broadway, Brooklyn, and 92d Street) across the East River. Similar results, no doubt, will be obtained in the case of the ferries across the Hudson River when the vehicular tunnel is in operation.

The distance along the water-front from Pier 1 to 14th Street is 2½ miles, one-half of which is occupied by railroads for ferry and freight terminals. It is confidently estimated that at least ½ mile of this water-front could be released for other purposes if this tunnel were constructed.

The passage in the New York Assembly of the bill providing for the construction of a tunnel or tunnels, and appropriating funds to commence the work, has very forcibly brought the attention of the public to the work, and criticism has been directed against the design approved by Gen. Goethals. First, it was the matter of ventilation, one of the scientific papers claiming that it would be impossible to ventilate it artificially. This paper, during the past month, has reversed its former opinion.

COUNT OVER EAST RIVER BRIDGES.

Mr. Byrne.

| OCTOBER 28TH, 1915 | | | DECEMBER 6TH, 1916. | | | OCTOBER 25TH, 1917. | | | MARCH 14TH, 1919. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Horse-drawn. | Motor-drawn. | Total. | Horse-drawn. | Motor-drawn. | Total. | Horse-drawn | Motor-drawn. | Total. | Horse-drawn. | Motor-drawn. | Total. |
| 2 628 | 1 731 | 4 359 | 2 193 | 2 397 | 4 590 | 1 910 | 3 150 | 5 060 | 2 599 | 3 604 | 6 203 |
| 3 813 | 5 587 | 9 400 | 3 167 | 8 105 | 11 272 | 3 093 | 11 266 | 14 359 | 1 363 | 13 250 | 14 613 |
| 5 442 | 3 396 | 8 838 | 4 670 | 4 644 | 9 314 | 4 029 | 6 248 | 10 277 | 3 344 | 7 806 | 11 150 |
| 1 818 | 7 687 | 9 505 | 1 554 | 8 304 | 9 858 | 1 226 | 12 205 | 13 431 | 2 444 | 11 895 | 14 339 |
| 13 701 | 18 401 | 32 102 | 11 584 | 23 450 | 35 034 | 10 258 | 32 869 | 43 127 | 9 750 | 36 555 | 46 305 |

The size of the tunnel and the use of pre-cast concrete blocks in place of cast iron, are now being made subjects of controversy.

The Governor's Reconstruction Commission has invited criticism of the Goethals plan, and a Committee of Engineers has recommended that the type of tunnel for this location be decided by a Committee of Subaqueous Experts.

The points raised by the Reconstruction Commission are:

1.—Is the type of tunnel proposed possible of construction?
2.—After it is constructed, is it usable?
3.—Are the estimates of cost anywhere near correct—in other words, will the State find that it has entered upon a programme of much more expense than it has in sight at the present time?

The size of the tunnel is unusual; its diameter is 42 ft. 0 in., and the diameter of the largest tunnel yet built is 30 ft. 0 in. A special type of shield to drive the tunnel has been designed by J. F. O'Rourke, M. Am. Soc. C. E. This shield, which is divided horizontally into four sections, has multiple air chambers in its forward part, each ending 3 ft. in front of the chamber immediately above, thus enabling the excavation to be done in separate vertical faces. Gen. Goethals has approved this shield, and states that it will do the work of excavating the tunnel.

Concrete blocks have never been used as lining in a subaqueous tunnel. They have been used in a land tunnel in Montreal, driven by the shield method, and have been found satisfactory.

It is known that concrete blocks have been used for bulkhead wall construction for many years in New York City, and no fault has been found as to their durability.

The proposed tunnel will be 9 300 ft. long. The roof is 50 ft. below mean low water. This depth has been fixed in a permit issued by the War Department for a tunnel at this location. For 4 000 ft. the tunnel will be practically level. The grade of each of the approaches is

Mr. Byrne.

fixed at 3½ per cent. Practically similar grades exist on the East River Bridges. The lengths of roadway approaches and grades of these bridges are as follows:

| Bridge | Approach | Length | Grade |
|---|---|---|---|
| Manhattan | Manhattan | 2 900 ft. | 3.10 per cent. |
| Williamsburg | Manhattan | 2 500 " | 3.00 " " |
| | | 1 500 " | 3.5 " " |
| Queensboro' | Queens | 3 600 " | 3.4 " " |
| Brooklyn | Manhattan | 1 562 " | 3.25 " " |

Ventilation experts have advised that the tunnel can be artificially ventilated. It has been stated that artificial ventilation is not necessary. This statement is based on the fact that two vehicular tunnels in London under the Thames are being used successfully without artificial ventilation, although at one of them the ventilation plant has been constructed and is ready for use if found necessary.

The London tunnels referred to are known as the Blackwall Tunnel and the Rotherhithe Tunnel. The Blackwall Tunnel, Fig. 5, is 6¾ miles below London Bridge. It is 6 200 ft. long and is lined with cast iron. The outer diameter of the tube is 27 ft. One roadway, 16 ft. wide, and two sidewalks, each 3 ft. 1½ in. wide, are provided. The minimum headroom is 15 ft. 6 in. The maximum grade is 1 in 36 (2.78%). The tunnel was opened to traffic in 1897. The contract price was £870 000; the cost of property, sites for rehousing, and miscellaneous, amounted to £536 000, a total cost of £1 406 000. The 1917 Report of the Public Service Corporation of New Jersey states that the annual traffic for 1913 was 772 940 vehicles and 3 742 241 passengers. An actual count during a period of 13 hours, in January, 1916, showed that 2 000 vehicles and 7 473 passengers used this tunnel, the greatest number of vehicles for any hour being 219.

The Rotherhithe Tunnel, Fig. 6, is 2¼ miles below London Bridge. It is generally similar in design to the Blackwall Tunnel, with the exception that the outer diameter is 30 ft., making it the largest subaqueous tunnel ever built. It is 6 826 ft. long, and has a roadway 16 ft. wide and two footwalks, each 4 ft. 8½ in. wide. The maximum grade is 1 in 37 (2.7%). The length of the river portion, between shafts, is 1 535 ft. The tunnel was opened to traffic in 1908. The contract price was £1 088 484; the cost of property, sites for rehousing, and miscellaneous, amounted to £911 516, a total cost of £2 000 000.

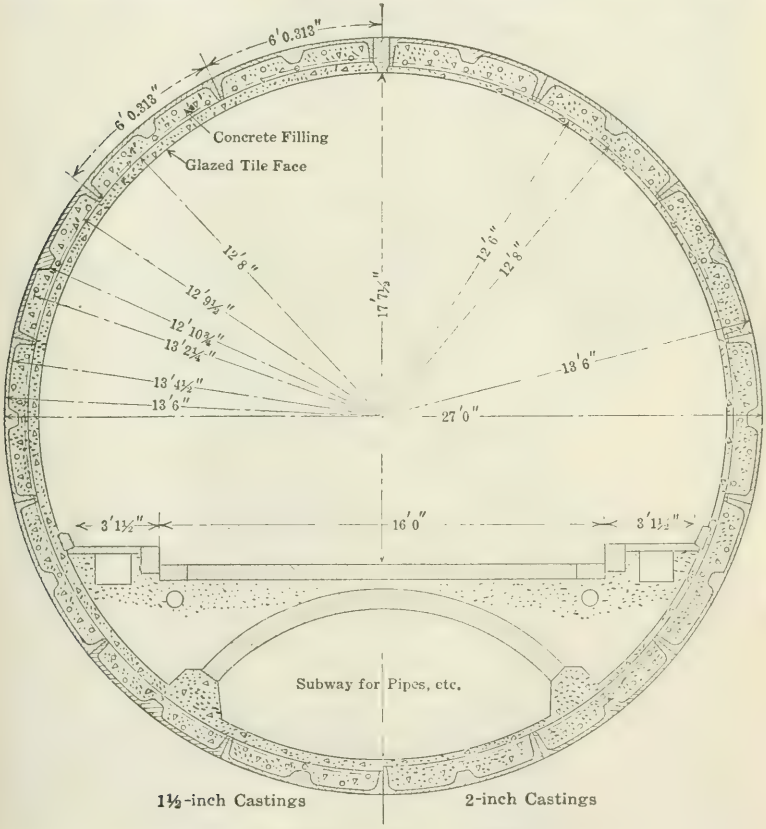
The 1917 Report of the Public Service Commission of New Jersey states that the annual traffic for this tunnel for 1913 was 937 946 vehicles and 3 360 067 passengers. From a count made in 1914, for a period of 12 hours, 8.00 A. M. to 8.00 P. M., 2 040 vehicles used this tunnel.

The heaviest traffic for any one hour, from the foregoing records of these two tunnels, was 219 vehicles for the Blackwall Tunnel.

The speaker's estimate of traffic through the proposed tunnel, of 15 000 vehicles per day, would mean a maximum of 1 300 vehicles per hour of heaviest traffic. This estimate is made from the count taken at the Manhattan Bridge on March 14th, 1919, on which day there was a total of 14 613 vehicles recorded as using the bridge for 24 hours, the heaviest hour traffic being 1 166 vehicles. Mr. Byrne

At a hearing before the Reconstruction Commission, Mr. O'Rourke submitted a proposal to build the tunnel complete ready for use for the sum of $11 500 000.

In answer to the criticism raised at the hearing, that the patented shield, concrete blocks, and gravel backing gave him exclusiveness in




BLACKWALL TUNNEL, LONDON

CROSS-SECTION OF TUNNEL, SHOWING TWO PATTERNS OF CAST-IRON LINING USED.

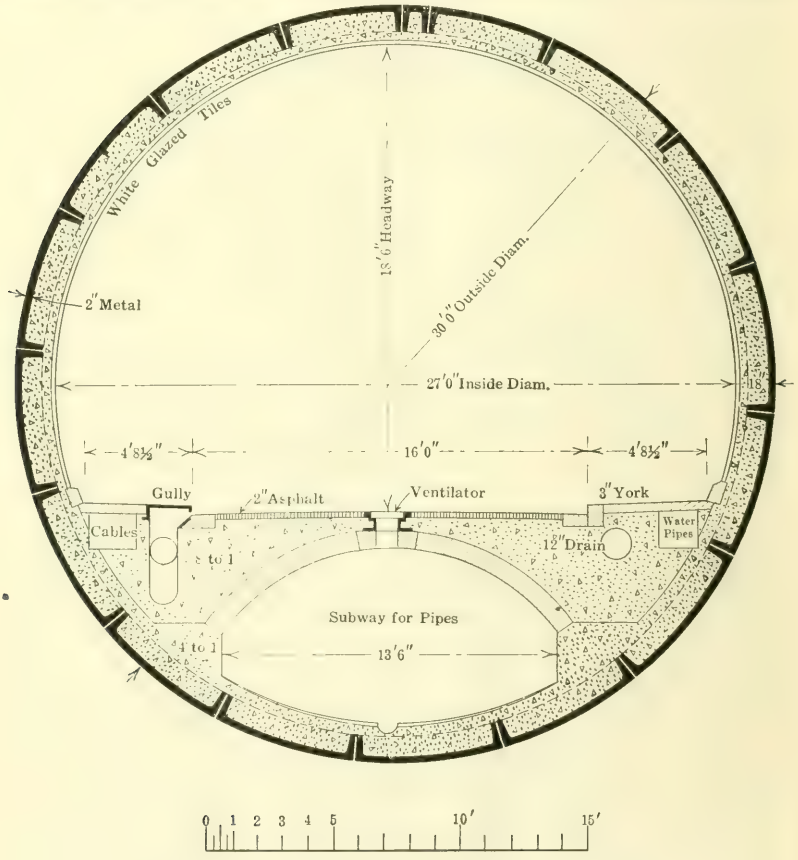
TYPICAL CROSS-SECTION OF A
LONDON TWO-WAY VEHICULAR TUNNEL.

FIG. 5.

Mr. Byrne.

bidding for the contract, he proposed to refer his interest in the matter to the Chamber of Commerce, with full power to fix his compensation for giving license to any contractor to use all the patents for the driving of this tunnel. This compensation was not expected to exceed one-quarter of the saving made by their use.

From an experience of many years with traffic on long-span bridges, there is no doubt in the speaker's mind that narrow roadways are not to be recommended for present-day traffic, as they are sources of congestion and blockade, particularly during the heaviest traffic periods. The failure of one vehicle to maintain its position at these times has been frequently the cause of the entire interruption of the vehicular




TRANSVERSE SECTION OF THE NEW ROTHERHITHE TUNNEL.
TYPICAL CROSS-SECTION OF A
LONDON TWO-WAY VEHICULAR TUNNEL.
FIG. 6

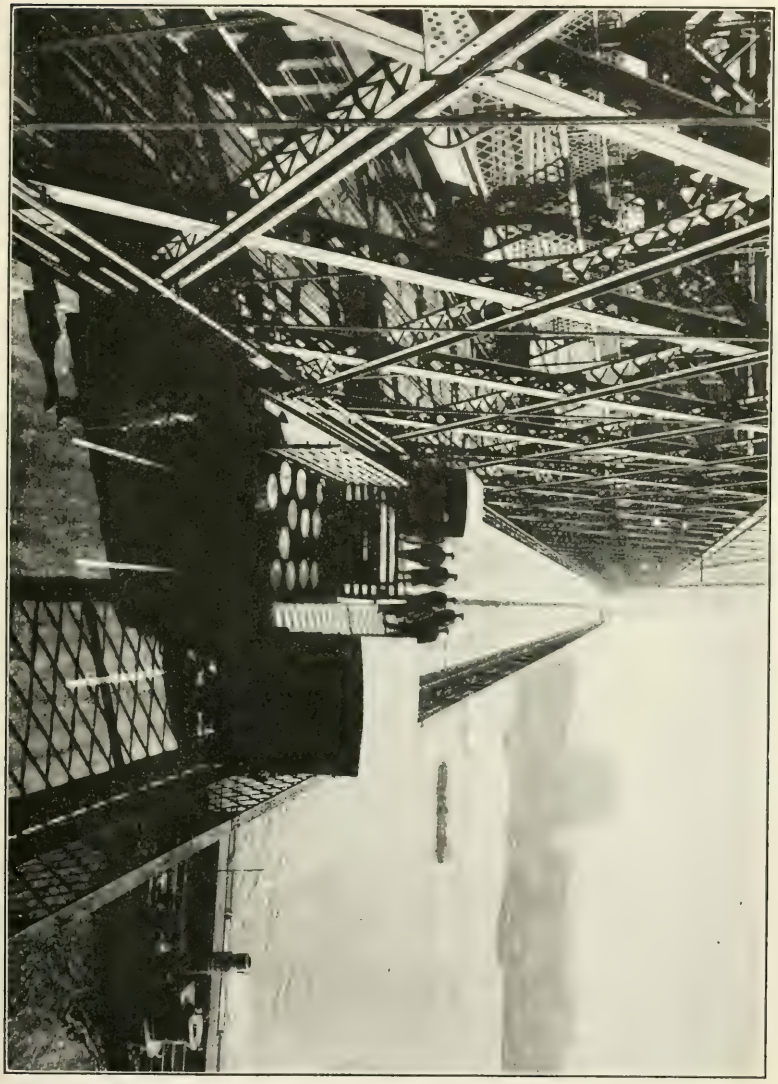


FIG. 7.—SHOWING HOW AN ARTESIAN 2 FEET

traffic across bridges which have narrow roadways. The Brooklyn and Williamsburg Bridges are examples of this narrow roadway error, but the roadways of the Manhattan and Queensboro' Bridges are free from congestion from this cause. Fig. 7 shows that the addition of 3 ft. to a 20-ft. roadway would permit of 3-way travel. Mr. Byrne.

It would require four 2-line vehicle roadway tunnels to equal the capacity of the tunnel approved by Gen. Goethals. The cost of these would be $22 000 000, by pre-war estimates, as compared with $12 000 000, by present-day prices, for the Goethals design.

Therefore, from a cost and efficiency point of view, the problem seems to be easy of solution.

JOHN F. O'ROURKE,* M. AM. SOC. C. E.—Mr. Byrne's description of the general conditions of the tunnel traffic question—about which he is probably as well informed as anybody in the world—and also what he has shown of the different types of tunnels, including that in which the speaker is interested, will probably leave little to be said on the subject of highway traffic, and so this discussion will be confined to certain novel features of the proposed Hudson River Vehicular Tunnel and some of the new methods involved. Mr. O'Rourke.

It is properly said that that tunnel is a large one, and that there has been no other like it in some of its features, but, in general, it is similar to the other Hudson River Tunnels, and in its vital features is exactly the same. The shield, also, is like other shields in all essentials, and, in addition, possesses two simple improvements which would have been used on former shields if they had been known.

Certain patents have been issued to various parties for methods of dividing the face of the shield into different levels, so as to avoid the unbalanced pressure caused by a height equal to the whole diameter, which exists where there is one chamber from top to bottom at the front of the shield. The first of these patents, for subdividing the front of the shield, was issued to Brunel in 1818, but it had nothing to do with compressed air, because that was before its use had been introduced in tunneling. The first patents for multiple air-pressure shields were issued about 1888. In 1891 the Pearsons, of S. Pearson and Son, of London, were granted a patent on a multiple air-pressure shield, the drawings of which show four levels, the same as the shield now under discussion.

At about the same time, the closing of the opening between the tunnel lining and the tail of the shield, in order to prevent the escape of air or the inflow of water, was attempted by Sir E. W. Moir, M. Am. Soc. C. E., of that company. He obtained two patents on the subject. D. L. Hough, M. Am. Soc. C. E., also obtained patents on means to close that opening.

* New York City.

Mr. O'Rourke.

The speaker has no knowledge that any of the tail-closing devices were ever tried, but the multiple air chambers were, and were not a success, because the faces of the excavation were all in one vertical plane. When the excavation had been carried sufficiently far downward, the air crept around the face of the floors from one level to another until the same pressure existed from bottom to top in all the chambers. In the new shield, as each chamber is projected beyond the one above, this cannot happen, because the air passes into the ground, where it expands as it rises, passing each chamber at less than the pressure in that chamber.

If there is anything that the speaker's experience with compressed air has taught him, it is that as soon as air escapes into the ground it expands and rises, for, no matter what its pressure was when it got out, it instantly takes the pressure of the ground-water it is in. The several chambers have the same air pressure as the ground-water at the level of their floor, and thus have a higher pressure than that in the ground in front of them, and, consequently, the escaping air cannot hold enough pressure to enter any chamber it is passing. If, for any reason, it moved backward as well as upward, across the step between the vertical planes of the excavation, the ground friction would cause an additional reduction in its pressure, further preventing it from entering the chamber above. Therefore, nothing is clearer than the fact that air escaping into the ground from one chamber cannot enter another chamber in which the air pressure is greater than that of the ground-water in front of it.

It has been stated that perhaps a boulder might be met at the front of a floor when shoving the shield, a contingency which is most likely. In pulling in or blasting that boulder, a hole is made of the same size as the boulder. The experts say: "What is to prevent air in large volume from going through this hole and entering the chamber behind?" The answer is that a large volume of air could not be contained in a hole the size of a boulder, and that the boulder must have been at least the width of the step in front of the chamber. All these things relate only to the work on shore, where sand and gravel are found. Under the Hudson River there is only silt, and the upper levels of the shield would never be opened to take in any of that. The effective cover could be counted on as from the top of the opening through which silt is being admitted into the shield, to the bed of the river or the top of the clay blanket, as the case may be.

As already stated, the efforts heretofore made to close the opening, between the tail of the shield and the tunnel lining within it, reached the point of taking out patents for devices. Stuffing the opening at the top with cement bags, or blocking it with steel plates against the end of the last ring, are about all that has been done to impede the escaping air. The bags were blown out at the next shove, and the

steel plates had to come down in order to erect the next ring, so that no real continuous checking of escaping air was accomplished. As the back of the shield under the lining was inaccessible, nothing was ever done to stop the water from entering at the bottom, except to raise the air pressure while the bottom plates were being set, whenever the water gave trouble. In order that the multiple air-pressure chambers at the front of the shield might have practical value, it was essential that this opening should be closed continuously against the escape of air or the inflow of water. Mr. O'Rourke.

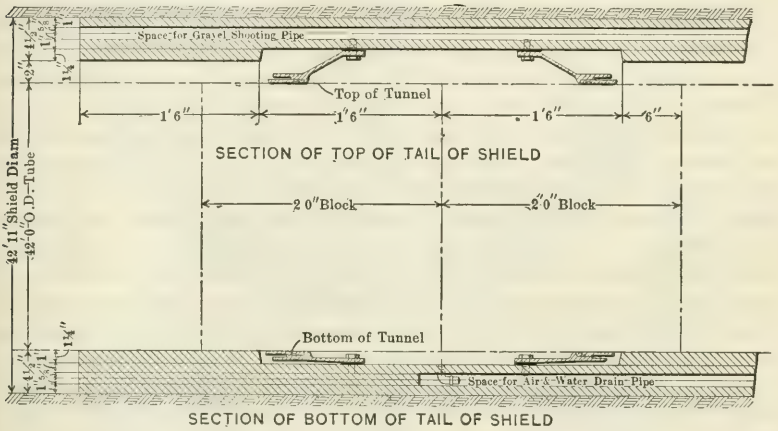



FIG. 8.

Fig. 8 shows how this is to be done by the simple expedient of providing a recess in the tail of the shield by two 1¼-in. steel-plate rings having a space between them in which two flap-valves, extending around the whole circumference, are fastened to the tail. The back one faces backward, and the water seeking to enter presses it down on the lining, making a water-tight seal, like the foot-valve of a pump. The front one faces forward, and the air pressure forces the flap down on the lining, making an air-tight seal, like a valve in an air compressor.

In this way the water is excluded and the air is contained, irrespective of the water or air pressure, so that, in connection with the multiple air-chambers, the excavation may be done without much unbalanced pressure under greatly reduced cover, and the tunnel itself can be given such pressure as may be most desirable, independent of the immersion.

It is likely that some lubricant may be used on the lining, to facilitate the slipping of the flap-valves during the shoves, and provision will also be made to pump back into the tunnel any water or

Mr. O'Rourke.

air that may accumulate between the valves and interfere with their operation. The valves will be strongly constructed, and should last through the distance the shield has to go, but, if necessary, they can be readily repaired or replaced.

Another matter which should be mentioned is the information obtainable in regard to the Canal-12th Street Line. It is obvious that that location must be right, because everybody who has projected a down-town tunnel has selected it. It was chosen first by Messrs. Jacobs and Davies. It was afterward adopted by the Commission of Engineers for the Public Service Corporation of New Jersey, and was also chosen for this latest tunnel. It is to be borne in mind that the Commission of Engineers, appointed by the Public Service Corporation to investigate the Hudson Vehicular Tunnel question, was given *carte blanche* as to the information it was to obtain, and also the extent to which its expenses might go. The three men on this Commission are among the most prominent bridge and foundation engineers in the country, and have had great experience in obtaining data for plans. The work of exploration necessary for foundations for bridges or buildings is necessarily much more extensive than any exploration for a shield-driven tunnel. In one case the work is from the top down, and it is important to know the material in which the excavation will be made and the kind of material at the bottom. In the case of shield tunnels, what is above the tunnel is of little importance, except as to whether it will or will not answer for cover. It is necessary that the ground under the tunnel be sufficiently compact to carry the load, and this can be done, even by silt, as experience shows, probably because the structure weighs less than the ground it displaces. As the shield can be driven through any kind of material, a few good borings answer all practical requirements, particularly in the Hudson River, where the shores and river bed have been tunneled so often. The same parties who were employed on the speaker's Pennsylvania Tunnels were engaged by the Commission, and made thirty-eight core borings into the rock from end to end of the tunnel site, even where the rock was 200 ft. below the grade. Therefore, the rock profile is very well known.

In addition to these borings, forty-two test piles were driven in the river bed. As the bed of the river consists of silt above the rock, with a foot or two of gravel and sand lying on the rock, the Commission is justified in the statement made in its report that it obtained the first and only complete rock profile under any of the rivers about New York City.

Fig. 9 shows the proposed interlocking concrete block tunnel, and the details of the blocks are given on Fig. 10. The projections are ¼ in. longer than the depth of the recesses, so that the blocks do not come in contact, except at the bottom of the recesses; that is to say,

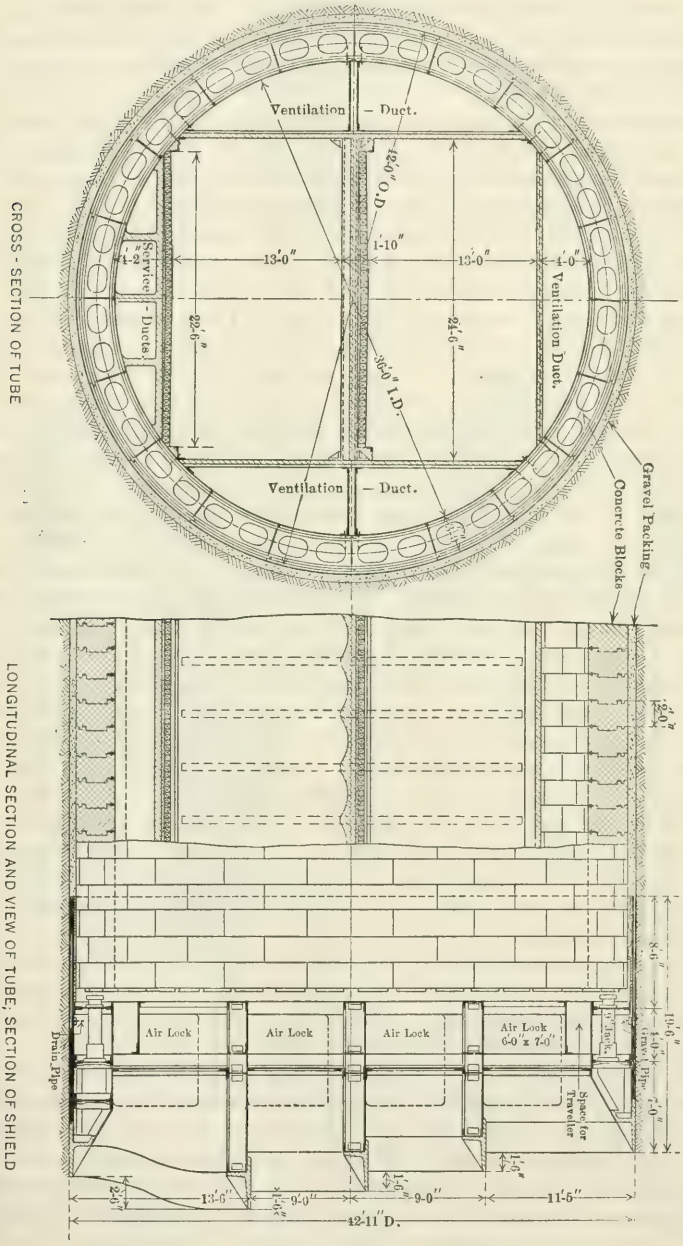

Ventilation — Duct.
42'0" O.D.
1'-10"
13'-0"
13'-0"
4'-0"
Service Ducts
4'-2"
22'-6"
24'-0"
Ventilation Duct.
36'0" I.D.
Ventilation — Duct.
Concrete Blocks
Gravel Packing
CROSS - SECTION OF TUBE
LONGITUDINAL SECTION AND VIEW OF TUBE; SECTION OF SHIELD
Air Lock
Air Lock
Air Lock
Air Lock 6-0" x 7-0"
Lock
Space for Traveler
Drain Pipe
Gravel Pipe
2'-0"
8'-6"
10'-6"
4'-0"
1'-6"
2'-0"
13'-6"
9'-0"
9'-0"
11'-5"
42'-11" D.

Fig. 9.

Mr. O'Rourke.

the pressure caused by shoving the shield is transmitted through the lines of projections and recesses, so that spawling is avoided, and the other parts of the joints are free and accessible for water-proofing, caulking, and grouting.

A key-way is moulded at the top of the joints, on one side and one end of each block, in which is put a mastic gasket, opposing which are projections from the oposite side and end, which compresses the mastic, thus completely filling all joints at the top.

At the bottom of the joints a caulking seam will be moulded, and filled with a well-driven caulking of oakum and tar, as a final line of defense against the entrance of any water that might pass the mastic and grout portions of the joints. Three blocks will be cast at a time, so that where the key-block shows at the top, requiring three special blocks, those three would be made in one operation. The parts of the joints inside the key-way and caulking seam, except a narrow smooth band for an exact ¼-in. joint in which spacers will be placed while the blocks are being erected, will be left purposely rough.

The size of the block, measured from the bottom of the recess to the face of the projection, must be uniform throughout, and all the moulds will have machined faces at these points, maintained at exact distances apart. There ought to be no more difference in the blocks, as to projections and recesses, than in fine machine work, because concrete fits its mould, and the moulds would be made with extra care at those points. Therefore, the blocks can be relied on to maintain contact throughout the line of projections and recesses. The jacks never let go of the blocks, except that when an adjoining block is being set, one jack is released on each side of a joint, after which the pressure is immediately restored. This means that the concrete block rings are always under compression. Assuming one-fourth of the jack power to be used for compression between shoves, this would equal about 50 lb. per sq. in. of ring. Concrete weighs 1 lb. per sq. in. for each foot of height, so that the rings are always under a compression equal to the weight of a section of tunnel, 50 ft. long, turned up on end; thus the rings are like courses in a pier, 50 ft. below its top, which are held in place by that much super-imposed weight. Therefore the concrete throughout the tunnel is given an initial compression which renders tension members unnecessary, as no longitudinal tension can exist.

It is proposed to use gravel packing around the tunnel lining throughout. This gravel is blown simultaneously through a number of rubber hose pipes inserted in passages in the tail of the shield. The gravel will be blown from many tanks into the space made by the shield outside the lining as it moves forward, completely filling that space. The gravel is to be composed of an equal mixture of coarse and fine grits, which are about the size of buckshot and birdshot.

Mr. O'Rourke.

The effect of the impact of the gravel on itself is to crush it into a hard mass, cemented like embryo sandstone by the powder into which some of it is reduced. In building inter-track stations, there has been occasion to take out portions of tunnel lining, where gravel packing had been used, and the lining seemed to be encased in sandstone. The Public Service Commission engineers took photographs showing cracks in the ground into which the crushed gravel ran, the same as grout would, and it was equally hard, for all practical purposes. In connection with the Hudson River silt, it is certain that gravel packing will hold the ground undisturbed and solidified where it surrounds the tunnel, so that its bearing power will be greatly improved.

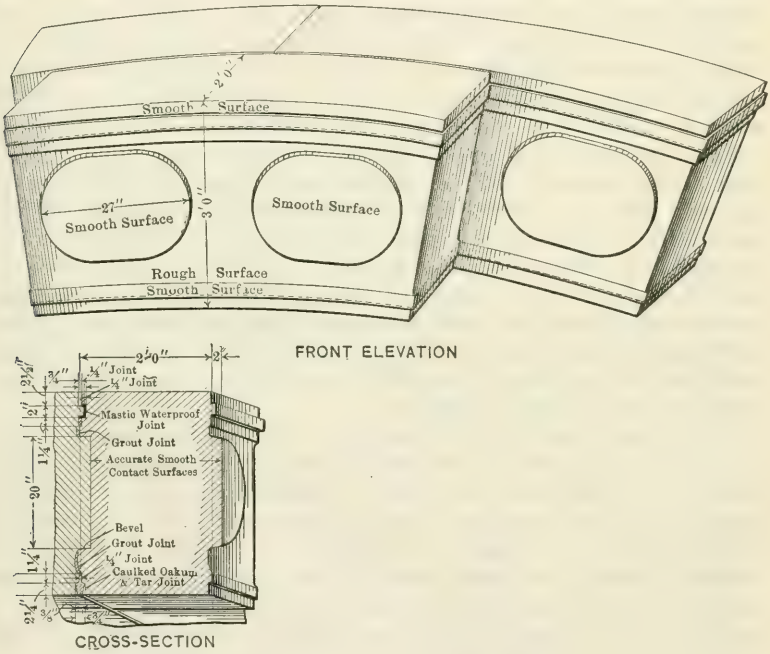



FIG. 10.

Some question has been raised as to the use of gravel packing in silt, through which the propelling air could not escape. In places where the ground is impervious, the shield provides means for returning the air that carries the gravel back into the tunnel through the same passageway that contains the hose. In a tunnel in Detroit, where bad settlements were occurring, gravel packing is now being used successfully in clay.

Mr. O'Rourke

The experience during the construction of the Pennsylvania Tunnels was that there were serious irregularities of pressure in the silt against the sides of the lining for about a year after the tunnels were driven. Shores and tie-rods were used throughout to maintain the rings in circular form, and these had to be retained for more than a year, after which the ground had settled uniformly around the tunnels, and the cast-iron rings retained their form unaided while the concrete lining was being placed. This would indicate that, if gravel packing had been used to prevent the disturbance of the silt, there would have been no trouble from unequal pressures at any time. It also proves that the alleged differences of pressure in undisturbed ground around the circumference have no distorting effects. A test was made in the Willoughby Street Tunnel by slacking off the turnbuckles. This was done without causing the slightest spreading of the sides of the tunnel, so that it is safe to say that the gravel packing enables the ground to hold the tunnel and the tunnel to hold the ground, in silt as well as in any other material; and that this large tunnel can be built, if gravel packing is used, without any deformation of the concrete rings or disturbance of the equilibrium of the ground. Moreover, the 36-in. interlocked concrete block rings are very much stronger than any cast-iron rings that could be built within reasonable limits of cost, and there is no question that where the weaker ring held its form assisted only by gravel packing, the stronger one will also, with the same assistance. Besides, these strong rings get further strengthening from the steel columns and floor, securely anchored to the lining so as to take tension or compression at six different parts of the circumference.

The lowest point in the Pennsylvania Railroad Tunnels was 97 ft., and the air pressure was about 25 lb. per sq. in. from one side of the river to the other, that is, much less pressure was required than the immersion would indicate. That answers the question, asked by Paul G. Brown, M. Am. Soc. C. E., as to the men in the bottom chamber working for short shifts while the men in the other chambers would be idle. As a matter of fact, this shield and this method do not call for any greater immersion than the Pennsylvania Railroad Tunnels.

The rock at the New York end of the tunnel would be taken out in a shaft, and not under compressed air.

In reference to the ventilation of the tunnel, an article * appeared a short time ago which was not meant to apply to this tunnel, as it had not been proposed when the article was written. In attempting to describe it, the writer of that article alluded to Mr. Davies' tunnel and to the tunnel of the Public Service Corporation. He assumed 52 sq. ft. as the area through which were to be diluted the fumes of

* *Scientific American.*

about 150 automobiles, averaging 15 h. p. each, and all supposed to be consuming gasoline at the highest rate. He then calculated the velocity and power required by using Kent's formula for ventilating mines. He assumed that the rough surface of the mine passages and the smooth surface of a ventilating duct have the same modulus of friction. As it is 0.002 in one case and 0.007 in the other, it will be seen that there is some difference. That article, however, is used to-day against this tunnel which has 250 sq. ft. of duct area, not to mention more than 600 sq. ft. of roadway which will also be used. Mr. O'Rourke.

The well-known law in regard to the movement of air is that the power required to move it varies with the cube of the volume, or inversely as the cube of the area of cross-section of the tube. If there were 52 sq. ft., 48 000 h. p. would be required, costing $2 600 000 a year. A duct having 104 sq. ft. would require one-eighth as much, or 6 000 h. p. Doubling that area again would give one-eighth of one-eighth of 48 000, or about 800 h. p. The actual duct area of this new tunnel would require about 500 h. p.

Ventilating apparatus was provided for the Blackwall Tunnel, but was never used, and no provision for ventilation was made in the next Thames tunnel. There are half a dozen other vehicular tunnels, none of which has induced ventilation, and where even pedestrians go without danger or inconvenience.

Mr. Parmley has discussed the subject of jacks and the slope that the earth takes around a tunnel, and how much more jack power will be needed. The speaker is familiar with nearly every tunnel that has been built in the vicinity of New York City, and has had to do with a great many kinds, both as engineer and contractor. There is one rule in regard to jacks and resistance to jacks in shields that is as true as that in regard to the weights put on a caisson in order to sink it, and that is, it is a matter of the area of rubbed surface. The diameter or dimensions do not matter. It is the rubbed surface that counts.

There is a rule, and it is more for construction reasons than anything else, that jacks in a shield are placed about 3 ft. apart, so that, if the diameter of the tunnel is known, the number of jacks required will be the same as the diameter, in feet. If a tunnel is to be driven under Brooklyn Heights, where there are 120 ft. of cover, and where the weight on top is several times as great as that on top of this tunnel through the Hudson silt, that rule could be followed as successfully as the speaker did, and no calculations will satisfy him that the jacks he used did not push those shields, because they did.

Then again, the question of the design of the blocks and the load that is forced on the blocks by jacks, was fully settled at Montreal, where there is a cover of more than 60 ft. above the tunnel, at least 40 ft. of which is that jelly-like substance known as "bull's liver".

Mr. O'Rourke.

The jacks used in the shields there were loaned by the O'Rourke Company to the contractors, Mackenzie, Mann and Company. S. P. Brown, M. Am. Soc. C. E., the Chief Engineer of the tunnel adopted these blocks without any precedent to guide him, and he and his principals are greatly pleased with the results. The speaker was familiar with the work while it was going on, and knows whereof he speaks.

At a recent hearing, in regard to the Hudson River Tunnel, before the Reconstruction Commission of the State of New York, Mr. Brown declared that, although the weight was so great that it crushed the footings of the shield, consisting of three 12-in. I-beams bolted together, with concrete in between, bent the center columns, and sometimes sheared the rivets of the channel-beams at the top of the columns, in no case was a concrete block even deformed. Further than that, with all this weight above, the jacks, approximately 3 ft. apart, pushed the shield, exerting 150 tons when the water pressure was 5 000 lb., and there was not a single case in which a projection on a concrete block was crushed. In other words, this tunnel with interlocking concrete blocks was driven most successfully under difficulties fourfold as great as those that will be encountered by the tunnel in the Hudson River silt.

The use of concrete blocks saves both time and money; nevertheless, the speaker's company is prepared to use either cast-iron or concrete lining.

Mr. Brown.

Paul G. Brown,* M. Am. Soc. C. E.—Only two weeks ago the Governor of New York State requested Engineering Council to appoint a committee of five engineers to advise the Reconstruction Commission of the State of New York in regard to proposed public works projects. To act on that committee two engineers of this Society were chosen. One of the first things the Governor asked the Reconstruction Commission to do was to report on the vehicular tunnel under the North River. It happened that only one member of the Engineering Committee had had tunnel experience, and as the Committee believed that it ought not to pass on such an important work, involving so many technical details, it recommended that the Governor refer the matter to a paid commission of properly qualified engineers.

Some months ago this Society, thinking that it was not performing its full functions in the affairs of the State and the Nation, appointed a Development Committee. This Committee has not yet reported, but, as it has seemed to be the desire that this Society should fill a large place in the community, the members now have a chance to assist the Governor of the State and perform that larger function, for, if those who are familiar with this kind of a proposition will say what they think about it, they will do a very good work for the State, and will

* New York City.

help the Governor, as he is very anxious to get all kinds of public improvements going. Mr. Brown.

There are many members of this Society who are capable of discussing such a project. Mr. M. L. Quinn has had much experience in tunnel construction, as well as Messrs. Davies, Forgie, Lavis, Mason, Haggard, Snyder, and Shailer; and there may be many others. If they will say what they think about this tunnel, the Committee and the Society can get behind their opinions without any question.

The Committee has been asked a number of questions, a few which are as follows:

Can such a tunnel be ventilated?

Can a shield, 43 ft. in diameter, be constructed of sufficient strength, without prohibitive weight and expense?

Would pre-moulded concrete blocks have sufficient strength to withstand the thrust of such a shield?

Could pre-moulded concrete blocks of the design suggested be made water-tight?

Would such blocks have sufficient strength to support the tunnel structure?

Is it possible to maintain compressed air at several stages of pressure in the face of a shield?

With four sets of air locks in the shield, would the concentration of so much effort at this point prove a serious obstacle?

Can a shield of such size and strength be kept to line and grade?

It is a well-known fact that a shield, if it cannot move ahead, will move downward; and, with the lower part of such a shield projecting so far beyond the upper, if it did settle, could it ever be brought up to grade?

This shield is 93 ft. below mean low tide, or 20 ft. lower than would be necessary with a smaller tunnel with correspondingly lower pressure. In the bottom chamber, through the rock sections, the "sand hogs" would only work short hours. The shield could move no faster than the bottom chamber. Would this make the progress so slow that the cost would be prohibitive?

Can any system of concrete blocks be designed for this tunnel that would be a proper substitute for the usual cast-iron lining?

Would the congestion of traffic at the terminals, due to the concentration into one tube, prohibit that type of construction?

Would two single tubes, if carrying two lines of traffic in each direction, be sufficient for the present traffic needs?

What units of cost are used in making the estimate of $11 500 000 for this tunnel?

The speaker hopes that this discussion will bring out many facts concerning this project.

Mr. Davies.

J. V. Davies,* M. Am. Soc. C. E.—The speaker is deeply interested in Mr. Byrne's presentation of this proposition, particularly with reference to the traffic. Information in respect to the actual volume of traffic to be expected in connection with these proposed highway tunnels has always been more or less deficient, and Mr. Byrne's statement of that feature is decidedly illuminating.

The speaker admires Mr. O'Rourke's presentation, and the ingenuity with which he solves all the various problems in connection with his tunnel. As Mr. Byrne, in his opening discussion, has mentioned the speaker's name, it would be well to clear up a little history in that regard.

A week ago, the speaker attended a meeting of the Reconstruction Committee, and stated then that he had been connected with the Interstate Commissions more or less, for some years. About 1910 the speaker's firm made a study of this proposition, and, as tunnel engineers, came into connection with the New Jersey Commission, in the first instance, and, later, with the New York Commission, in working out this vehicular transportation proposition.

In 1913 his firm reported to the Commission on this subject, and advised that two plans were feasible; one was a tunnel of large size, approximately 30 ft. in diameter, which could be built in pairs, one for east-bound and one for west-bound traffic. Each of these could be further divided, for slow vehicles on one level and for fast vehicles on a second level, and thereby give great capacity for traffic.

The other proposition was for smaller tunnels, of the general size of those built by the Pennsylvania Railroad; and, at the request of the Commissions, that one single and definite plan should be reported on to the Legislatures, his firm prepared the report of the Commissions, which was forwarded in 1913 to the Legislatures of the States of New York and New Jersey, recommending a pair of tunnels of the smaller size.

Now, the point of this was very simple. The members of the speaker's firm had no information, other than their own personal knowledge, of the conditions north and south of the location that had been laid out for this vehicular tunnel, and were not prepared to make any wild gamble as to what might be done, but preferred to stand by what they knew could be done; and, further, the two Commissions had no money available with which to make investigations of any sort.

In 1914, George D. Snyder, M. Am. Soc. C. E., presented this subject of subaqueous vehicular tunnels, in a paper† which contains most of the structural information presented by Mr. Byrne. That paper treats of all subaqueous vehicular tunnels, and covers Mr. O'Rourke's proposition, as well as the various plans of open-trench tunnels.

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* New York City.

† *Transactions*, Am. Soc. C. E., Vol. LXXVIII, p. 252.

Mr. Davies.

Now, there is one thought that should be brought out clearly, and that is, that there never has been at any time any assembling of these various propositions, so as to compare them on the same basis of costs. Mr. O'Rourke's plan for a very large tunnel may be quite feasible, but it would have to be considered in detail before the speaker would feel equal or capable of saying whether or not it was desirable. These plans must be brought to a sane basis for comparison.

Mr. Byrne states that the tunnels, to give a capacity equal to Mr. O'Rourke's design, would require four of the type which the speaker had recommended to the Commission, and would cost $24 000 000, whereas Mr. O'Rourke's design would cost $11 500 000. There is evidently something radically wrong in such a comparison. This thought should be brought up squarely. The displacement and consequent excavation of a 43-ft. tunnel, which represents the shield that Mr. O'Rourke has designed, represents 53 cu. yd. per running foot. A pair of 24-ft. tunnels represents only 33 cu. yd. per running foot. There is 60% more excavation per running foot in the large tunnel than in the two of smaller size.

Of the cost of construction of a tunnel, more than 50% is represented by the labor and other costs expended in producing the hole, that is to say, the excavation and contingent work to prepare for the insertion of the lining; and probably not more than 20% of the total cost is in the iron lining itself. This fact is worthy of careful consideration.

Then, another point: The builder of this large tunnel must consider that the roof grade is approximately at the same roof grade as the smaller tunnels, that is, any excess in diameter is at the bottom. The intersection with the rock reefs on each side comes at earlier points at the two ends, and the most expensive part of the tunnel driving is from the moment the rock reefs are touched and work has to be done in a rock bottom with a soft ground top; thus, the increase in the cost of the excavation comes sooner and is in larger amount.

There are approximately only 3 000 ft. between the rock reefs on each side. On the New Jersey side, above the rocks there is sand, which is as bad as rock, inasmuch as every bit of it has to be excavated. The shield cannot be shoved into it an inch until it has been excavated. That proposition has to be considered.

Another point, with respect to New Jersey, is the fact that any new tunnel must be located so that it will be above the plane of the tunnels of the Hudson and Manhattan Railway, the tubes of which at the location of intersection, are superimposed, lying one on top of the other, leaving a comparatively shallow depth between the surface of the yards of the Erie and Lackawanna Railroads and the roof of the tunnels below, so that whatever construction, of whatever type, must go above those tunnels at that point of intersection.

Mr. Davies.

Therefore, although this discussion should, and undoubtedly will, draw out a lot of very valuable information, it is not thought that any one will arrive at a very definite conclusion; and, further, all these plans should receive very serious and careful consideration on their merits, at some time or other, before any definite, final adoption of any one of them is made.

Mr. Forgie.

JAMES FORGIE,* M. AM. SOC. C. E.—The speaker is surprised to find that this public highway tunnel discussion pertains chiefly to a shield-driven tunnel of definite design, having an external diameter of 42 ft., and to be lined with pre-cast concrete blocks.

The economic necessity of a highway tunnel under the Hudson is quite obvious, and is only second to the pressing necessity for a railroad freight tunnel connection, though it is of little consequence which is built first. In 1892-96, in London, they built a vehicular tunnel, in which the speaker obtained his baptism of compressed air, the Blackwall Tunnel. This tunnel was so successful that another was built, the Rotherhithe Tunnel, completed in 1908. London's industrialism can distribute itself in almost any direction, and is not confined, as is that of Manhattan; so that, for New York City there must be still greater reason for a vehicular tunnel to connect it with the mainland. New York City is a clearing house for the continent, and in that capacity has a very great, pressing, and all-sufficient duty to discharge.

The speaker feels considerable diffidence in saying anything on the matter of design and method of construction of this tunnel; but is attracted by Mr. O'Rourke's proposed cross-section which is to accommodate two superposed roadways, each with three lines of traffic in one direction. Of course, a one-way road of three lines of traffic has advantages over one with two lines of traffic, but, to realize it in one tunnel, in the way suggested, may or may not be economical.

There are many things that require serious study and consideration in connection with the construction of a tunnel of normal size, and each tunnel project, even under the same waterway, becomes an individual problem. Much as the speaker would like to give his unqualified opinion, he does not think it wise to do so, on this occasion, on this large tunnel, of 42 ft. external diameter, lined with concrete blocks, and proposed to be constructed with a multi-air-pressure-shield. Therefore, he wishes it to be understood that anything he may say should be considered as general, but definite enough to give cause for reflection. He hopes he does not seem to be obstructive or over critical, but, from practical experience, he has reason to believe that a shield 42 ft. in diameter in this case presents unusual difficulties. With probably unusual knowledge as to the conditions of tunneling under the North River, conditions which thus far stand

* New York City.

alone, the speaker feels he is on well-known ground in dealing with tunnel problems under that waterway. Of the matters requiring notice he will but mention a few, and will refrain from detailed comment on the proposed shield and methods, beyond saying that he believes that Nature, as represented in atmosphere and geology, would not adjust itself to either in a way to conform with the practical requirements of tunneling. A shield and its tunnel lining constantly and harshly disagree; each must have a simple and tough constitution, free from pulmonary troubles suggested to the speaker by the proposed shield and conjunctive mining methods. Mr. Forgie.

On the New York side, at the Canal Street location, any tunnel, large or small, would be interfered with by a stretch of rock reef, and, the larger the tunnel, the greater would be the length of this interference, or tunneling in part rock overlaid with silt. The harbor dredging plane is 40 ft. below mean low water, and the minimum cover, in the speaker's opinion, should be about 20 ft.

With a tunnel 42 ft. in diameter, the length of this mixed ground to be tunneled through would be much greater than with a smaller or single-deck tunnel, and a greater differential air pressure would be required during the excavation of the rock reef. Any differential air pressure required would be 9 lb. greater than in a tunnel of the size of the Pennsylvania Railroad Tunnels, and those who are experienced know the difficulty of providing extra cover to meet such a condition and the trouble of keeping it in place.

The speaker is bearing in mind that this is solely a North River tunnel discussion, and that, while shoving a shield blindly through the silt, the air pressure used is generally the equivalent of a hydraulic head of from 5 to 10 ft. above the crown of the tunnel; but, also, when it is necessary to excavate in this selfsame silt ahead of the shield, the air pressure had to be about equal to the hydraulic head. The latter would be the air condition when excavating the rock reef, so that, if the air pressure required to dry out the ground over the rock surface near the invert of a 23-ft. tunnel was 6 lb. greater than is necessary at the crown, then, under similar conditions, this differential force would be 15 lb. in the large tunnel in question. This, added to the air pressure necessary at the crown, requires a somewhat impossible blanket cover.

This large tunnel would require a shield with a cross-sectional area of more than three times that of the Pennsylvania Tunnels and about seven times that of the Hudson and Manhattan Railroad Tunnels. In passing through silt, the latter were driven by displacing almost all the silt, and taking in little or none of it. This plan was tried on the Pennsylvania Railroad Tunnels in silt, but the grade could not be maintained, the tunnel rising unduly above it. Therefore, an average of about 35% of the tunnel displacement had to be

Mr. Forgie.

taken into the tunnel, at times none, at other times from 10 to 100%, but on the average, about 35% of the tunnel bulk throughout the entire length in silt. To the speaker these two cases indicate that the larger tunnel will require a greater proportion of silt to be taken in, and also creates questions in one's mind, concerning the propulsion as well as the steering of the shield in silt, which is governed greatly by the quantity of muck taken sausage-like through the shield.

Further, it is the speaker's opinion that a tunnel structure of reasonable cost in silt has to be flexible during the period of construction, the silt acting on it like a fluid, and the shield demanding that the lining follow it in what is never a straight path. A cast-iron tunnel circle, 23 ft. in diameter in the shield, becomes from 2 to 3 in. greater in vertical diameter, and correspondingly less in horizontal diameter, shortly after the shield leaves it; and, months later, it returns to its original shape. This distortion, in a tunnel of 23 ft. exterior diameter, will not be any less in one of 42 ft. exterior diameter, and in the speaker's opinion, it is not economically practicable to resist it structurally. With cast-iron lining, the plates are more or less free to slide on one another, and the character of the bolting permits further flexibility, though at times a segment is broken without either weakening or endangering the tunnel; with concrete blocks, this inevitable action has also to be borne in mind. Under the land the action is the reverse of that in the silt under the river, and was resisted by turnbuckles and posts.

It is essential that the tunnels be made as water-tight as possible, but it may not be difficult to decide whether this can be done most readily, economically, and permanently with a machined cast-iron structure or a concrete block structure.

The cost of a tunnel is greatly dependent on the speed of construction; practically the same over-all and labor costs have to be borne, whether the rate of construction is 6 or 16 ft. per day. Metal lining can be built very expeditiously by men having comparatively little experience or skill, and it is doubtful if any such performance could be approached with concrete blocks, in this case, because the speaker thinks the behavior of the shield in silt would not be very agreeable to that kind of lining, also in this case. The words "in this case" are repeated because the speaker wishes to see the use of concrete blocks, in shield-built tunnels, where safe and practicable.

Since the Compressed Air Labor Law and the War have greatly increased the prices of labor and materials, the speaker has not made a specific estimate for a tunnel under the North River. However, without apprehended difficulties, and with the assumption that the scheme is feasible, the known increase of difficulties, and the increased market rates of labor and materials, it is the speaker's opinion that the estimate of cost cited is insufficient to cover the plan under discussion.

Mr. Forgie.

The speaker has probably said enough to indicate that, in his opinion, this project of a 42-ft. tunnel requires more study; and that definite opinions cannot be given on this occasion nor in this way; besides, to him it has seemed that, on some matters, the premises are uncertain. The speaker has considered this discussion as informal, and has been pleased to join it in that spirit, though by no means irresponsibly.

Mr. Thomson has referred to the North River tunnels in silt as rising and falling with the tide, as does a floating body. That is the reverse of the case, as tidal rise (load) compresses the ground, and the tunnel, as a part thereof, goes with it, falling with the rise and rising with the fall a very little, as occurs in any ground structure subject to alternations of load. Briefly, in this connection, the tunnel does not move within the silt.

Mr. Parmley.

W. C. Parmley,* M. Am. Soc. C. E.—That the time has already arrived when there is pressing need for more ample traffic accommodations between New York City and the Jersey shore requires no argument. As a citizen and tax payer of New Jersey for many years past, the speaker feels a personal interest in the matter of more adequate communication between the metropolitan center and the districts west of the Hudson River.

The 36-ft. tunnel plan advocated by Mr. O'Rourke certainly appeals to the imagination, and its great traffic capacity is a very compelling argument in its favor, provided the difficulties inherent in a tunnel of this size are not such as to offset its advantages.

The broad water barrier between the States of New York and New Jersey has already been set at naught by the completion of six tunnels, and there can remain no doubt as to the practicability of building more tunnels of approximately similar size and by similar methods; but as the proposed tunnel is nearly double the diameter of bore of any river tunnel yet built, and has nearly four times the area of heading, one wonders whether the difficulties of the kind encountered in the existing tunnels might not become embarrassing in a structure of this size.

The depth below the surface, necessary in order to give protecting cover, would be great, and also the pressures on the completed tunnel and the thrusts required of the jacks to push the shield ahead. In some places the ground is soft, approximating a hydrostatic condition, and at other places, in firmer material, there will be an entirely different distribution of the loads. These variations must be given full weight in the design of the tunnel section, but, before this can be done, it becomes essential to establish limiting relations between the vertical and horizontal components of the earth pressure. This relationship

* New York City.

Mr. Parmley.

also affects vitally the matter of pushing the shield and the ability of the newly erected tunnel lining to withstand the pressures without serious crushing, shearing, or splitting.

The published data in regard to driving the Pennsylvania Railroad Tunnels and the Hudson Tubes furnish important information on this subject. Messrs. Hewett and Brown, in their paper* on the Pennsylvania Railroad Tunnels, state that a number of the cast-iron segments lining the tunnel were broken by the unbalanced pressure of the ground. As this number was considerable (166 as reported), the conclusion is that they were being loaded well up toward their ultimate strength. If this assumption is correct, then, by finding the moment of resistance of the cast-iron lining and comparing it with the pressures and stresses due to earth pressure under different degrees of fluidity, one can deduce, at least, a rough idea as to the probable intensity of these pressures on a tunnel of the large diameter which it has been proposed to build.

As a check against this method of argument, the total thrust of the jacks in pushing the shield with all doors closed has been compared with the total combined weight of the earth and water over the tunnel, thus arriving at a ratio of static resistance of the earth to the total vertical weight. Then, by Rankine's formulas, the corresponding fluidity of the ground has been deduced. Without giving the details of these two calculations, it may be stated that they lead to substantially the same results. That at times the jacks were pushed to their limit is indicated by the statement of Messrs. Hewett and Brown, that the pistons had a tendency to bend, and that it would probably have been better if the diameter of the plungers had been 10 in. instead of $8\frac{1}{2}$ in. Furthermore, some of these same jacks were used for the shield of another tunnel, to which reference will presently be made, and it was found that, on account of bending, all had to be overhauled and re-aligned before they could be used.

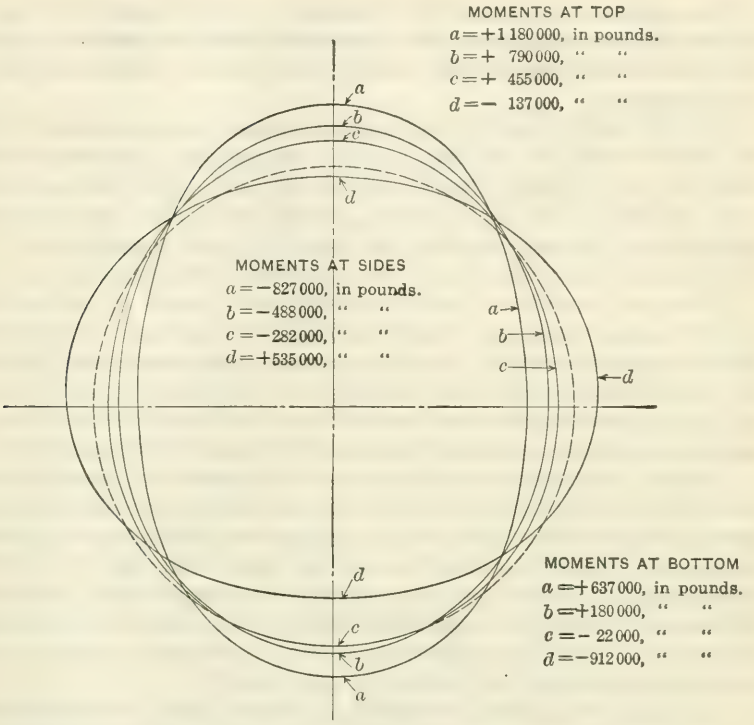
In order to cover a wide range of softness of the earth, the pressures and moments of the 23-ft. Pennsylvania Railroad Tunnels were calculated for headings that would theoretically stand on natural slopes of $3:1$, $4:1$, $6:1$, and $\infty:1$. The last is the condition of hydrostatic pressure.

To shorten the story, Fig. 11 shows the equilibrium polygons for the four cases named, together with the approximate moments at the crown, the springing line, and the invert.

Now, taking into account the axial thrusts, and dividing each of these moments by the section modulus of the cast-iron lining segments at each of the points shown, the approximate stresses in the cast iron, for the different conditions of the earth, have been computed and are shown in Table 2.

* *Transactions*, Am. Soc. C. E., Vol. LXVIII, p. 152.

Mr. Parmley.


MOMENTS AT TOP
a = +1 180 000, in pounds.
b = + 790 000, " "
c = + 455 000, " "
d = − 137 000, " "
MOMENTS AT SIDES
a = −827 000, in pounds.
b = −488 000, " "
c = −282 000, " "
d = +535 000, " "
MOMENTS AT BOTTOM
a = +637 000, in pounds.
b = +180 000, " "
c = − 22 000, " "
d = −912 000, " "

APPROXIMATE EQUILIBRIUM POLYGONS FOR DIFFERENT KINDS OF MATERIAL SHOWN, AND FOR AXIS OF TUNNEL RING 39 FT. IN DIAMETER.

*a* for earth having natural slope, 3 horizontal to 1 vertical
*b* " " " " " 4 " " 1 "
*c* " " " " " 6 " " 1 "
*d* for Hydrostatic (fluid), " ∞ " " 1 "

FIG. 11.

TABLE 2.—APPROXIMATE TRANSVERSE STRESSES IN CAST-IRON LINING, IN POUNDS PER SQUARE INCH.

| Material. | Top. | Sides. | Bottom. |
|---|---|---|---|
| 3 : 1 | + 25 300 | − 16 100 | + 13 000 |
| 4 : 1 | + 16 300 | − 9 600 | + 38 000 |
| 6 : 1 | + 8 600 | − 4 000 | + No tension. |
| Hydrostatic pressure | − 900 | + 9 700 | − 17 900 |

Mr. Parmley.

The algebraic signs in Table 2 indicate on which side of the axis the line of pressure comes, the plus sign indicating tension on the inner side of the ring and the negative sign tension on the outer side of the segment.

The different values for the maximum stresses correspond well with the known values for cast iron, but it is interesting to note that those found by A. N. Talbot, Past-President, Am. Soc. C. E., for cast-iron pipes tested by him, which would provide conditions more closely applicable to this case, as they were obtained from curved instead of from straight specimens, ranged from 21 000 to 33 000 lb. per sq. in.

From an inspection of the foregoing results, taken in connection with the actual breakages, it seems plain that the ground has natural slopes of approximately 3 : 1 or 4 : 1, as most of the breaks were in the top of the tunnel, with a few in the invert, indicated by Table 2 as the points producing the most intense stress, and these stresses in turn correspond with the moduli to be expected in the cast-iron segments.

Interest in the hydrostatic condition lies mainly in showing the direction in which the variation of stress travels as the ground becomes more and more fluid. It would also appear that both the vertical and horizontal pressures are functions of the depth, and that the limits of horizontal to vertical intensity probably lie between about 50% for the case of 3 : 1 material, and about 60%, for the case of 4 : 1 ground, results which also agree with values obtained by taking account of the pressures required of the jacks, as already stated.

Although it is probable that the air pressure, due to its drying-up effects on the earth, causes the latter to offer a greater horizontal resistance to the shield movement, and correspondingly less horizontal pressure on the tunnel ring than it naturally does, the error, if any, in both cases, is on the side of safety in these calculations.

It would appear from the foregoing that, including the effect of air pressure it would be necessary to provide ram power equal to the static resistance of earth having a natural slope of 2 horizontal to 1 vertical. This requirement would give to the Pennsylvania Railroad Tunnel shield 3 150 tons, where actually 3 300 tons were provided. In similar manner, the shield of the Hudson Tubes would have required about 1 600 tons, where 2 000 tons were actually provided. Reduced to a square-foot heading basis, the effective push of the jacks in the Pennsylvania Railroad Tunnel amounted to about 8 tons and in the Hudson Tubes to about 9 tons.

The conclusion, therefore, is that in any large-size tunnel, such as is now proposed, because of its greater depth and the increased possibility of encountering denser material, not less than 10 tons per sq. ft. of heading should be provided.

If this conclusion is justified, one is led naturally to ask the following questions, and on their affirmative answer depends the possible success or failure of a concrete lining in such a tunnel as now proposed. Mr. Parmley.

*1st.*—In a tunnel of 36 ft. interior diameter, what thrusts and bending moments will the ring be subjected to, and will a 36-in. thickness of ring be sufficient?

*2d.*—Will the 36-in. ring be able to carry the thrusts of the powerful jacks that it will be necessary to use?

*3d.*—Will the concrete lining courses be able to resist the shearing and bending produced by the jacks?

In answer to the first question, it may be stated at once, without going into detail, that a 36-ft. tunnel, 3 ft. thick, with 25 ft. of earth and 45 ft. of water above its top, and with earth of a character which gives a horizontal pressure equal to 50%, or less, of the vertical, the crushing and bending stresses on an unsupported ring would be destructive. At the crown the thrust would be about 85 000 lb. per lin. ft. of tunnel, combined with a moment of more than 3 400 000 in-lb. If acting on a plain concrete section, even though no joints occurred at the crown, it would mean a crushing force on the outer edge of the ring of 2 500 lb. per sq. in., and in tension on the inner edge of more than 1 100 lb. per sq. in. The corresponding stresses at the springing line and the invert would also be destructive. More extended calculations for the thrusts and moments at the critical points, for the variations in the character of the ground noted, show that a ring, 48 in. thick and heavily reinforced, would be necessary to meet the conditions safely.

With a ring 36 in. thick it becomes absolutely essential, therefore, that it be supported and fixed at several points by interior walls and floors. Only in this way can the line of resistance be kept near the central line and safe pressures on the concrete be secured. The same statement also may be made regarding a cast-iron segment ring of reasonable thickness.

It should be noted here that the upper horizontal floor, occurring at about the upper quarter points, should be made to act primarily as a tension member, and that additional strength should be given to the inside of the tunnel ring at the crown by suitable reinforcement or bracing. The invert, also, would need similar attention. All points of support for walls and floors must be designed to become effective immediately after the shield is pushed off the block rings, otherwise, destructive effects might be experienced. If, however, these provisions are properly taken, the ring, in so far as these factors are concerned, may be made safe, and the first question may be considered as answered satisfactorily.

Mr. Parmley.

As to the second question, regarding the pressure of the rams on the concrete itself: If a pressure of 10 tons per sq. ft. is used for the 42-ft. heading under consideration, the total pressure becomes 13 800 tons, and this, if distributed uniformly around the center line of the concrete ring, requires 111 tons per lin. ft. of the circumference. If the ring is made up of sixteen blocks, as shown in the published plans for the tunnel, there would be thirty-two jacks of 430 tons each. At a pressure of 5 000 lb. per sq. in., the plungers would be 15 in. in diameter—rather formidable looking affairs, to say the least. They would be 3 ft. 10 in. from center to center around the center line of the concrete ring. Now, if it were possible to distribute this pressure evenly over the entire area of the face of the concrete ring, the pressure on the concrete would still be 520 lb. per sq. in. Such even distribution, of course, is impossible.

If a system of lug contacts between the blocks is used, in order to prevent beam and shear effects, it would be necessary to limit the number of contacts to two per block. These contacts, therefore, would of necessity be of considerable size, or the excessive concentration of pressure would result in splitting and bursting the blocks. To increase considerably the areas of these contacts would result in the same difficulty in distribution as in the case of plain block-to-block contacts; otherwise, bursting concentrations would result. That a large amount of distribution is necessary is evident from the pressure given for the case of complete ideal distribution.

The only adequate way out of the difficulty seems to be to use a series of aligned cores extending through the body of the blocks from front to back, and against which each jack may re-act directly. These cores can be made of high resisting material, slightly longer than the width of the blocks, so as to operate loosely through the blocks, or, they may be manufactured in the blocks and retained therein by frictional means. They may be made of a rich mixture of cement inside a heavy steel hooping, or completely encased in iron pipe. In this way a compressive resistance of 5 000 lb. per sq. in., equal to that of the jacks, or even more, could easily be secured. They would have the advantage that any crushing effect would not affect the block proper, and need not throw any strains on the blocks, due to irregularities in their position in the ring.

They can also be made with a small cap at the end, of weaker material, which will crush and thus automatically give the needed distribution of pressure over the end of the core. They may also be made to serve most effectively to pin and lock the blocks of one ring to those of the adjacent rings, as the contact of core to core can readily be made to occur either between the rings or within the body of the block itself.

Mr. Parmley.

A further and very great advantage of the core method lies in the possibility of applying four instead of only two jacks to each block. With fixed bearing surfaces, it is not possible to use more than two contacts to the block, because that would imply absolutely perfect bearing of ring to ring, but, if the cores are used to transmit the reactions independently of the ring blocks, the number may be increased to any extent desired.

With four jacks per block, the number is increased to sixty-four, and the diameter of each is reduced to $10\frac{1}{2}$ in., with a maximum of 215 tons per jack. These jacks would now be more in line with the sizes already used, and the fact that the cores may be permitted to slip in the blocks and adjust themselves would permit equalization of the pressures and result in a completely interlocked lining, sound and suitable to withstand its proper burden. The second question, therefore, may be considered as answered in the affirmative, if these precautions in the design of the ring are taken.

Taking up the third question, in regard to shearing stresses, it is obvious that the shear that otherwise would be sustained by the blocks is now transferred wholly to the cores. That this precaution is absolutely essential may be shown by a simple calculation.

Suppose there is a ring of blocks, 36 in. thick and 18 in. wide, or a sectional area of 648 sq. in. per ring of block tunnel. Consider a block lining in which the longitudinal joints are broken. In the absence of perfect bearing of block against block along the entire length of the circumference, one of the jacks bearing on the block will act against an overhanging end of one-half the length of the block, thus setting up both bending and shearing stress in it. A 430-ton pressure would thus give a mean shear over the cross-section of the block of 1 380 lb. per sq. in. It is thus evident that the block would fail, either in bending or shear, almost before the jack had been adjusted to its serious work.

On the other hand, by using suitable cores, the shearing stresses in the block can be practically avoided, and, in so doing, it is also relieved of bending stress.

A statement was made in a New York paper of March 16th, 1919, to the effect that the use of concrete blocks would be experimental, as this method had never been used before. This statement is in error. Sewer tunnels of concrete block construction, designed by the speaker, and costing hundreds of thousands of dollars, have been built with entire success, and have been substantially water-tight. The new water-works tunnel at Cleveland, Ohio, costing upwards of $1 000 000, with which the speaker was connected in a consulting and constructing capacity, was built successfully with reinforced concrete blocks. It is 10 ft. in inside diameter and is built of rings of reinforced blocks 11 in. thick. The length of the tunnel is about 15 000 ft., and its

Mr. Parmley.

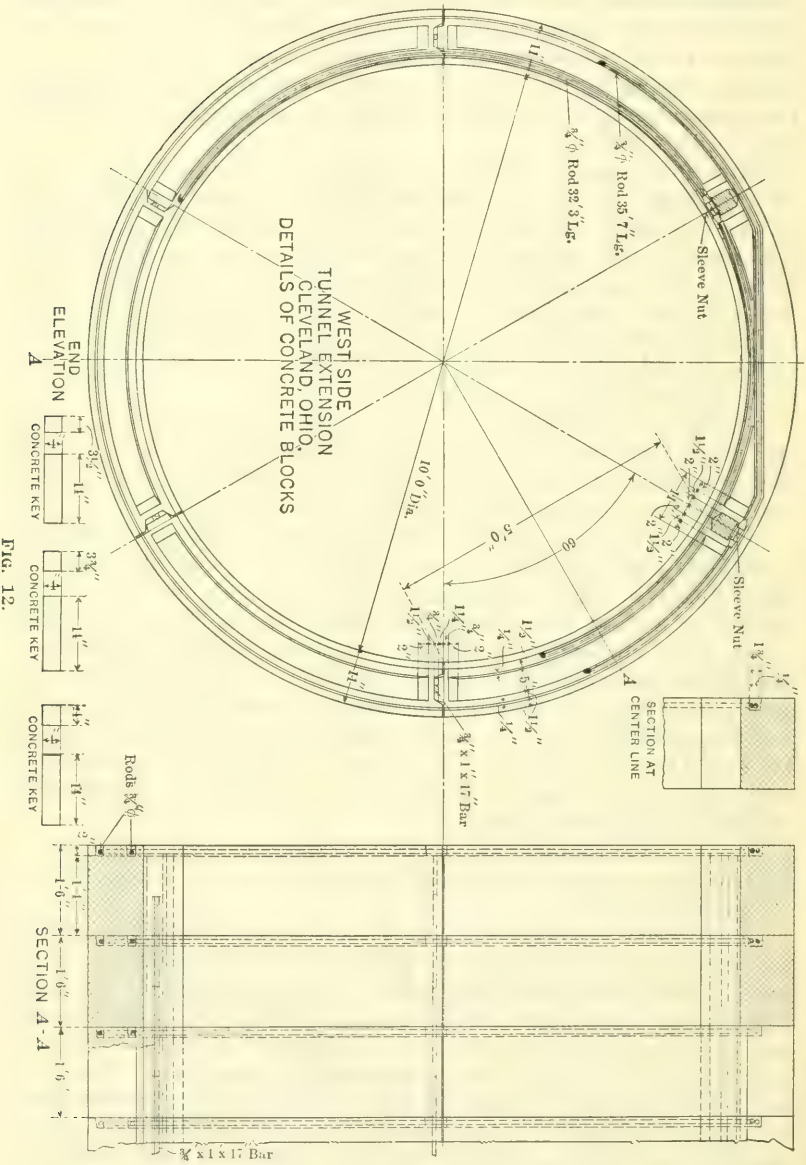
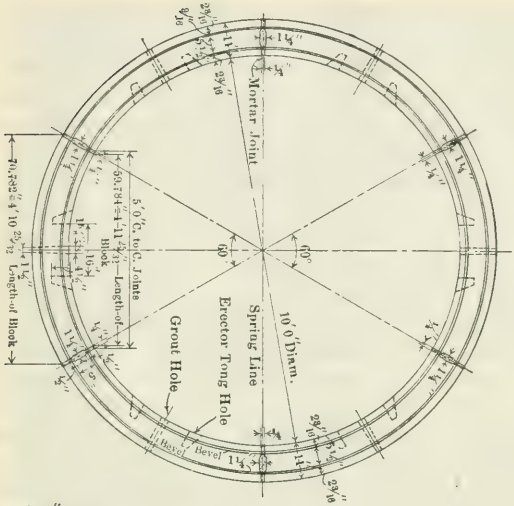
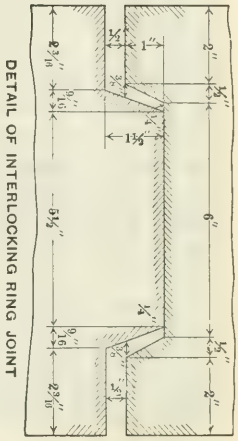


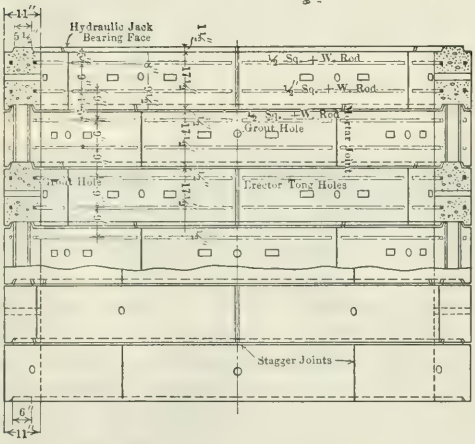

FIG. 12.

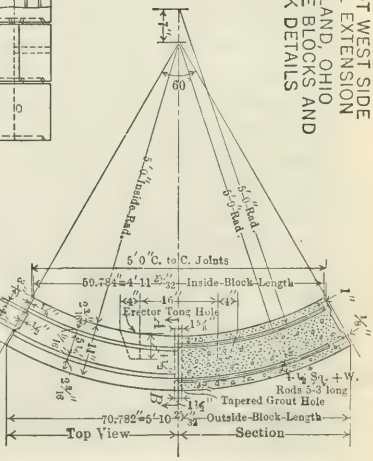
Mr. Parmley.




TEN FOOT WEST SIDE TUNNEL EXTENSION CLEVELAND, OHIO CONCRETE BLOCKS AND BLOCK DETAILS



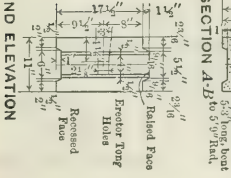




FIG. 13.

Mr. Parmley.

center is about 95 ft. below the surface of Lake Erie for the entire distance. Therefore, it carries a burden of from 40 to 50 ft. of soft clay and sand overhead and about 50 ft. of water, for its entire length.

For most of the work, an air pressure of from 15 to 25 lb. was used, and the shield, which was about 12 ft. 2 in. in diameter, was driven forward by twelve 8½-in. jacks, which, at 5 000 lb. pressure per sq. in., gave a thrust of about 137 tons each, or a total of 1 650 tons. The speaker believes that they were never driven to their limit. In order to start the shield, about 3 000-lb. pressure was used, but, as soon as it moved, the pressure was reduced, and only about half as much was necessary to maintain the forward movement.

At a pressure of 3 000 lb. per sq. in., and considering full and ideal distribution of pressure on the block ring, a thrust of about 430 lb. per sq. in. against the concrete blocks was developed. Of course, it was impossible to get this ideal distribution. Part of the tunnel was built with continuous longitudinal joints, and part with the longitudinal joints broken.

At the pressures mentioned, some spalling of the blocks resulted, and, in the portion laid with longitudinal joints broken, there was still more spalling, and a number of blocks were sheared. It is evident that, if the jacks had been worked to their limit, considerably more damage to the blocks would have resulted, even with the best distribution of the pressures possible by using wood blocking.

It was the behavior of concrete blocks under jack reactions, as thus actually observed, and the damages resulting, which convinced the speaker that, in order to insure the success of concrete block lining for this undertaking, it will be essential to take the precautions which have just been discussed.

Whether the tunnel is to be a single barrel of large dimensions, divided up for the different roadways, or twin tunnels of smaller diameter, it will be necessary to take such precautions, but, if they are taken, there seems to be no reason for not using a concrete block lining with entire success and safety, without involving the large expense of cast-iron or cast-steel segments. The tunnel can be made water-tight by the grouting process. Its construction involves the entire elimination of one major process—the cost and erection of the cast-iron segments—and the quality of the concrete in the blocks will be of a far higher quality and uniformity than can be obtained in practice where the concrete is deposited in mass within the tunnel.

Mr. Thomson

T. Kennard Thomson,* M. Am. Soc. C. E.—Not one, but several, tunnels should be constructed between New York and New Jersey.

The ventilation can be easily taken care of; but separate compartments should be provided for foot passengers and horse-drawn vehicles, and for fast and slow motors.

* New York City.

FIG. 14.—CONCRETE BLOCKS FOR LINING CLEVELAND WATER SUPPLY TUNNEL.

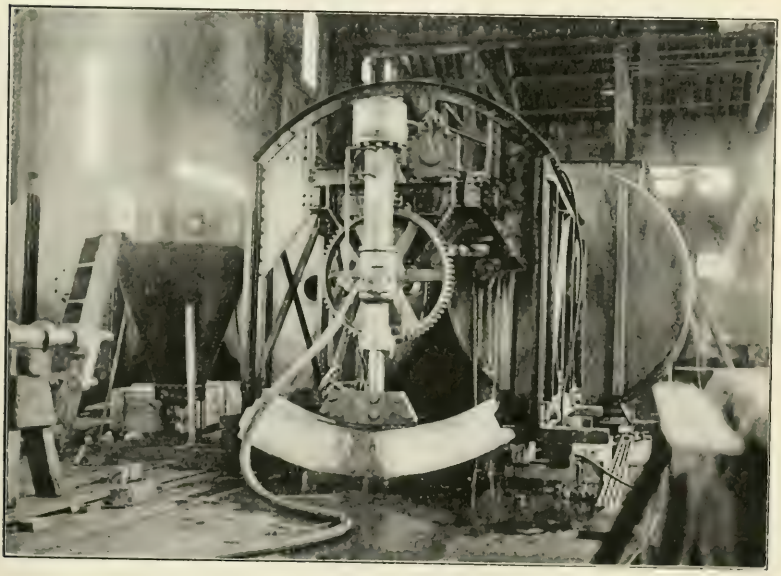


FIG. 15.—MACHINE FOR SETTING CONCRETE BLOCKS FOR CLEVELAND WATER SUPPLY TUNNEL.

Mr. Thomson.

The first requisite for a tunnel should be safety; the second, permanence; and the third, economy.

A shield-driven tunnel under the Hudson River does not, and will not, comply with any one of these three requirements, as compared with what can be done by the trench method. The reason for this is that the Hudson River silt is about 200 ft. deep, and any tunnel in it must perforce be a floating tunnel. For, if its weight is made just right without any live load, it will be too heavy with trains or vehicles in it. In short, it is a physical impossibility to design a tunnel which would always be in equilibrium. As a matter of fact, the Pennsylvania Tunnel, probably the best lined tunnel in the world, rises and falls with every tide.

James Forgie, M. Am. Soc. C. E., in a remarkably complete monograph* on this tunnel, has given a very good description of the value of this silt for bearing purposes. He explains that the shield, 23 ft. in diameter, could have been driven across without excavating any material whatever, except for the difficulty of keeping the tunnel in its proper location, so, as a matter of fact, from 30 to 60% of the material was excavated, and the rest was squeezed out of the way. Who would ever think of building a house on material that could be squeezed so easily? He states, further, that the tunnel itself was subject to distortion when a second tunnel was being driven alongside.

Now, a tunnel that rises and falls with the tides, as perforce any tunnel must which is shield-driven through this material, would be likely sooner or later to get a water-jacket around it, and, if this ever happened, a catastrophe might result, as the tunnel lining, as usually built, would not stand much tensile strain, especially in a longitudinal direction.

The proposed concrete blocks would not be nearly as strong as the lining of the Pennsylvania Tunnels, which is composed of heavy cast iron with 2 ft. of concrete.

Surely it would be better to construct a tunnel which would always be rigid and in a state of equilibrium, and would remain permanently where put. This can be done easily by the open-trench method, that is, by dredging a channel and driving an ample number of foundation piles, so that the tunnel could never sink any lower, and then make the tunnel so heavy that it could never rise, and so wide that it could never bend. It could be built on the surface, like a boat, with bottom, sides, and roof of reinforced concrete, say, 6 ft. thick. It could be in lengths of 1 000 ft. or more, and when ready could be towed into position and easily sunk on the piles. An air chamber could be provided below it, in order to permit any additional excavation, if desired, after the section had been sunk.

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* *Engineering News*, February 28th, 1917, p. 228.

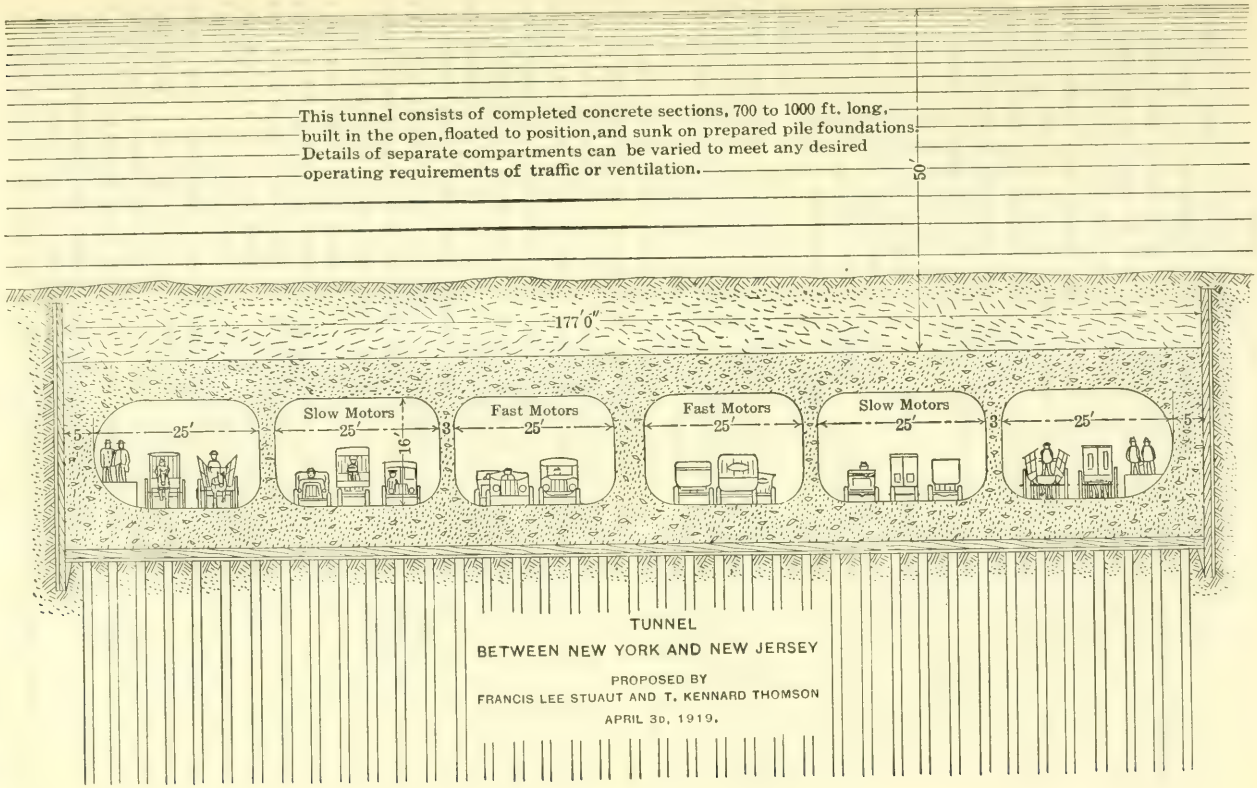


FIG. 16.

Mr. Thomson.

There are many ways of making the joints between the sections after they are in position, but the speaker's method would be to sink pneumatic caissons over the joints. Mr. Thomson.

The proposed 43-ft. tunnel has two compartments, one for each direction. That means that horses and fast and slow motors going in one direction would all travel in one compartment, thus preventing real speed. The trench method would permit of six compartments, each larger than those proposed for the shield-driven tunnel. In this way horses, slow motors, and fast motors would be separated from each other by walls of concrete 3 ft. thick.

Obviously, a trench tunnel can be placed at a higher level than a shield-driven tunnel, especially in such fluid material, thus shortening the approaches by 1 000 ft. or more, which is a great advantage. Such a trench tunnel, Fig. 16, is proposed by Francis Lee Stuart, M. Am. Soc. C. E., and the speaker, and would have three times the capacity of the shield-driven tunnel, without costing any more to construct, and be safe beyond peradventure of a doubt, as no shield-driven tunnel ever can be without going to unheard of expense.

F. Lavis, M. Am. Soc. C. E.*—This discussion has been very interesting. There can be little doubt that it is desirable to establish communications between New York City and New Jersey by means of a vehicular tunnel, or even several of them. The question of design, however, needs serious consideration, and the speaker does not believe that this is the place to decide the merits of the various proposals. The salient points which affect a decision as to the proper design have already been pointed out, and the speaker does not intend to go into that matter further. Mr. Lavis.

Mr. O'Rourke's section has many features to commend it, if it can be built, but it certainly is a most serious matter to commit the future of an enterprise like this to a type of construction which presents so many serious difficulties of execution, and which has not been tried out in some way.

It is a long time since the speaker has had anything to do with actual tunnel construction, and he is inclined to look at all these matters from the standpoint of people who are asked to provide the money for various enterprises. He is inclined to think, therefore, that if the construction of a vehicular tunnel to New Jersey were to be carried out by private enterprise, there would be, to say the least, a great deal of hesitation in making a commitment, involving some $12 000 000 at the lowest estimates, with so many uncertainties involved.

Of course it is realized that, if no one had ever ventured into the unknown, there would never have been any shield-driven tunnels, or much of anything else, and the speaker does not wish for a moment to say that Mr. O'Rourke's scheme cannot be carried out. It is realized,

* New York City.

Mr. Lavis. also, that it is not altogether the same to advocate the expenditure, in some cases, of public money to aid in the progress of the Arts and Sciences; so that the use of public funds for the purpose cannot be put on exactly the same basis as the use of private capital.

Just at the present moment, however, in view of the tremendous demands for capital all over the world, demands which will exceed the supply for so many years in the future that we cannot see the end, it behooves every one to be rather more conservative than usual. At any rate, if the section proposed by Mr. O'Rourke is so much more desirable than others, if the cost of its construction—in case of the success of his scheme—is thought to be enough less than others to warrant it, the logical thing to do would seem to be to make the experiment, at least on a large enough scale to determine its feasibility, before commitment to the whole enterprise.

Now, aside from the merits of one scheme or the other, there is the proposal of Mr. Brown that this meeting should decide the matters of controversy. The speaker does not think it is at all the function of this Society as such, or of the meeting, to advise any one on a proposed engineering project relating to civil affairs. During the war all have given their time and services to the Government, in so far as they have been required, but, in a matter of this kind, which is one of ordinary civil and commercial life, the speaker would suggest that it is a proper subject for a properly appointed commission of qualified engineers, who should be paid for their services and for their knowledge. The camouflage of the word "reconstruction" ought not to cover the giving of engineering advice gratuitously to the Government—Municipal, State, or National.

Mr. Tomkins. Calvin Tomkins,* Assoc. Am. Soc. C. E.—Transportation between New York and New Jersey is the crux of port organization in New York City. It is not a local problem, but extends from New York City to Albany, for, with the exception of one bridge of insufficient capacity (that at Poughkeepsie), there is no all-rail crossing. The consequence is that, to the already congested lighterage transfer at the Port of New York, there is added the large transfer of continental business between New England, Canada, and the remainder of the United States. In some way improved all-rail communications between these parts of North America must be secured, and thus avoid the convergence of the congestion at the Port of New York. For passenger service this has been accomplished with the tunnels of the Pennsylvania Railroad, and now the same thing must be done for freight.

The vehicular tunnel project is commendable as a first step toward solving the freight problem, but it still involves the necessity of breaking bulk in New Jersey and the transfer of freight by truck or lighter to New York City. That, indeed, is better than the present

* New York City.

Mr. Tomkins.

method of effecting transfers between New York and New Jersey, but it necessitates the continuance of the railroad terminals in New Jersey, and, on that account, is not economical. In addition, a vehicular tunnel will only provide for service to Manhattan; it will not reach to Long Island, except across the bridges.

For motor truck traffic the tunnel is all right, but the all-rail connection is needed, not only with Manhattan, but across that Borough to New England and to connect with the Canadian Railroads. In other words, if New York City is to obtain the greatest port advantages possible, there must be done for freight what the Pennsylvania Railroad has done for passenger transportation. The vehicular tunnel project is welcomed as a step in the right direction, but only as a beginning.

When the railroad tunnels for freight have been completed, the conditions in New York City will be comparable to those which obtain at every other port in the world. The port is unique in being divided into two parts by the Hudson River barrier, which necessitates an immense transfer by floating equipment. This caused the coal famine in 1917-18, and is responsible for the strike in 1919, because the nice adjustment of the intricate floating machinery can easily be made unworkable by labor disturbances.

This great floating transfer must be abolished. Every other port in the world is accessible from all sides by railroads which lead to those ports, and such railroads can be made to connect with each other and with the docks, warehouses, and factories by a loop system of terminal railroads. Everywhere, except only at the Port of New York, this kind of railroad terminal distribution is in operation. Since the war placed the railroads under one administration, correct railroad integration has been established at all United States ports except only New York. At that port the Government is now largely in control of the transfers by water, and much of the former friction and expense incident to private separatist control of equipment has been done away with. When the Long Island and New Jersey systems are connected, and, incidentally, Manhattan is connected with both, freight can be transferred cheaply and advantageously from one side of the harbor to the other.

The steamships, factories, population, and wealth, are, for the most part, on the east side of the port, and the greater part of the railroad terminal system of the country is on the west side. The two parts must be joined, and thus make transportation a continuous process.

Let this tunnel project, then, be regarded as the first important step toward a complete union of the two sides of the port, which will make New York like other great seaports and remove from it the unenviable distinction of being the worst organized of the large ports of the world.

Mr. Schaeffer.

AMOS SCHAEFFER,* M. AM. SOC. C. E. (by letter).†—It is not clear why a tunnel 42 ft. in diameter should be built, even if it is possible to do so. All the economies which are claimed for a tunnel of this size could be applied to one of smaller diameter. Practically all the quantities will be greater for one large tunnel than for two small ones. The shield will weigh more and cost more to build, the quantity of material to be excavated will be greater, and the quantity of concrete for the block lining will be greater. As the number of points of attack for two smaller tunnels would be greater, and the material would be handled through double the number of shafts and by double plants, two tunnels could be driven much more rapidly than one of the larger size.

Therefore, estimates of cost, as between one large tunnel and two small ones, should be based on the use of the same materials. If it is practicable and economical to use concrete block lining in the large tunnel, it is likewise practicable and economical to use it in the smaller tunnels. On this basis, two smaller tunnels, without doubt, could be shown to cost less than the larger one.

It is not intended to enter into a discussion on the merits of concrete block lining, but simply to point out that if its use is practicable in one case it is in the other, and, therefore, that it is unfair to compare the cost of a large tunnel lined with concrete blocks with that of two smaller ones lined with cast iron.

The capacity of the proposed tunnel is greater than necessary for the present needs of traffic and those of the immediate future. It provides for two levels, with three lines of travel moving in the same direction on each level. A capacity of 100 000 vehicles per day is claimed. From the best information available, this estimate is based apparently on the following rates of speed and distances apart of vehicles:

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | miles | per | hour, | 50 | ft. | apart. |
| 9 | " | " | " | 60 | " | " |
| 15 | " | " | " | 80 | " | " |

These assumptions require a 24-hour day to provide a capacity of 100 000 vehicles.

It is believed that at least two of these assumptions need revision, in order to make a determination of the maximum capacity. A 12-hour day is the longest that should be used as the time basis. It is well known that traffic will not use a highway to its maximum capacity for 24 hours continuously.

In view of the distance within which motor vehicles, moving at various rates of speed, can be stopped by the application of brakes, the spacing of vehicles can be reduced.

A horse-drawn vehicle, moving at the rate 3 miles an hour, can be stopped within a distance of a very few feet. Motor vehicles moving

* New York City.

† Received by the Secretary, March 28th, 1919.

Mr. Schaeffer.

at the rate of 9 miles an hour can be stopped within a distance of 9 ft., and those moving at the rate of 15 miles an hour can be stopped within a distance of 21 ft. With a margin of safety of not less than 100%, these spacings can safely be reduced to 30, 40, and 60 ft., respectively.

On this basis, with the same rates of speed, and a 12-hour day, the maximum capacity of a tunnel with six lines of traffic would be 37 000 vehicles in one direction, or 74 000 in both directions.

It has been assumed that, at the completion of the tunnel, say, in 1922, 4 000 vehicles per day would use it in each direction, or 8 000 in both directions. This would be only about one-ninth of its capacity. The Commission assumes an annual increase in traffic of 5 per cent. This rate of increase was used undoubtedly more to show the small amount of traffic which would produce sufficient revenue to pay the interest, amortization, and maintenance charges than to indicate the traffic which could be expected.

On the assumption that traffic would increase at the rate of 8% per annum, there would be 37 160 vehicles using it per day in 1942, or 20 years after its completion, which is still only one-half its maximum.

It would seem, therefore, that a tunnel with a diameter of 42 ft. is probably considerably larger than is needed at first.

Two tunnels with a capacity for two lines of traffic, traveling at the rate of 3 and 9 miles per hour, and with 30 and 40 ft., respectively, between vehicles, would have a maximum capacity for a 12-hour day of about 41 000 vehicles in both directions, which is five times the capacity required at their completion, and would be ample for the traffic in 1942, 20 years after their completion.

It is admitted, of course, that six lines of traffic in three tunnels will not give as large a capacity as six lines in one tunnel on two levels, but it is believed that the smaller cost of two tunnels and the postponement of the construction of additional tunnels until they are needed, will largely compensate for this.

There is still another, and perhaps the most important reason, for constructing two smaller tunnels instead of a large one, namely, traffic conditions in Manhattan.

With the experience which New York City has with traffic, the concentration of six lines of vehicles moving in opposite directions, within a small area, cannot be considered good planning, unless there are overwhelming reasons for it, such, for example, as the provision of additional roadways on the East River bridges, where the cost of construction to support the dead load is so much in excess of that to support the live load that the cost of providing for additional lines of traffic is relatively small.

In tunnel construction by the shield method, the cost of providing for additional lines of traffic will be more nearly in the ratio of the additional facilities.

Mr. Schaeffer.

With the entrances and exits as close together as they are shown on the plan, there would undoubtedly be confusion of traffic on account of its movement in opposite directions and congestion on account of its volume within a small area.

This objection can be overcome by locating the entrances of the smaller tunnels a block or two apart. If future tunnels are needed, it would be preferable to locate their entrances some distance from those already constructed on both shores. It is not conceivable that all traffic would have Canal Street, Manhattan, or 12th Street, Jersey City, as its objective points. Traffic, therefore, would be served very much better if additional tunnels were built at some point farther up the river, say, at about 14th Street.

In the latter part of 1915 the Police Department took traffic observations at street intersections at more than 200 points in New York City. This count showed a traffic ranging from 29 200 vehicles in 10 hours at Columbus Circle, to 7 000 vehicles in the same time at Madison Avenue and 59th Street.

In 1908, the north- and south-bound traffic on Fifth Avenue at 42d Street was 8 945 during a period of 10 hours, and, in 1916, it was 16 860 for the same time, showing an increase of 90% in 8 years. As everybody is familiar with the congestion of traffic at this point, these figures will serve as a measure of traffic at other points.

The traffic which may be expected to use the tunnel in 1942 has been estimated at 37 160 vehicles, which is exclusive of the normal traffic which will use the streets at and about the entrance to the tunnel. This is more than double that which existed on Fifth Avenue at 42d Street in 1916 and is only 50% of the capacity of the tunnel. In other words, the construction of a tunnel of the capacity proposed would create a congestion of traffic greater than that for the removal of which the city is at present expending approximately more than $625 000 in the construction of the ramp at 34th Street and the Viaduct between 40th and 42d Streets on Park Avenue. These improvements are made primarily to provide a thoroughfare on Park Avenue for the purpose of relieving congestion of traffic on Fifth Avenue. Before the full benefits from this improvement can be derived, it will be necessary to acquire the right to use the roadway around the easterly side of the Grand Central Station, which was formerly Depew Place. It is estimated that the cost of acquiring this right and making the necessary changes will involve an additional sum of $625 000, or a total of $1 250 000.

It seems inconsistent, therefore, to create a condition, at large expense, in one part of the city for the removal of which large sums are spent in another. It would seem that there are abundant reasons, aside from the structural uncertainties in a large tunnel, which indicate the construction of smaller tunnels than the one proposed.

AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

# PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications.

## ON A NEW PRINCIPLE IN THE THEORY OF STRUCTURES

### Discussion.*

By Messrs. C. W. Hudson, Edward Godfrey, Irving P. Church, John I. Parcel, L. J. Mensch, and F. E. Turneaure.

Mr. Hudson.

C. W. Hudson,† M. Am. Soc. C. E. (by letter).‡—The writer has read this paper with great interest and has verified the derivations of the numbered equations. The general statement involved in Equation (3) he has not seen before, and the same may be said of Equation (4). In the short time in which the writer has studied the possibility of the application of Equation (4) to determine the angular rotation of any normal section of a bar, he is unable to see that it has any advantage, from the labor-saving standpoint, in shortening or abbreviating such calculations. Equations (1) and (2) and the further well-known equation, $\Delta \alpha = \int \frac{M\, d\, s}{E\, I}$, furnish the basis for the solution of all the problems which may be solved by Equation (4), and it is believed by the writer that the resulting solution of many problems would be the same, term for term, in either case. As the author states, it is often desired to find the angular rotation of the axis at a definite point of a bar subject to flexure. This, of course, is the same in direction and amount as the angular rotation of a section normal to the axis at the point. For about 16 years the writer has been using Equation (2) to determine the angular rotation of certain planes for which the author

* This discussion (of the paper by George F. Swain, Past-President, Am. Soc. C. E., published in March, 1919, *Proceedings*, but not presented at any meeting), is printed in *Proceedings* in order that the views expressed may be brought before all members for further discussion.

† New York City.

‡ Received by the Secretary, April 14th, 1919.

Mr. Hudson.

shows the application of Equation (5). If the auxiliary force of unity, imagined in the application of the general Equation (2), is considered as applied parallel to the axis of a straight bar at any cross-section of the bar and at a unit's distance from the axis, the deflection at the point of application of the unit force, divided by unity, is the angular rotation of the cross-section, in radians. As illustrations:

Equations (7) and (8) of Case I are seen to follow directly from Equation (2), with the aid of Fig. 14.

For the various equations derived for Case II: Equation (9) will be seen to follow directly from Equation (2), in connection with Fig. 15.

The slope at the load ($\alpha_l$) is obtained from Equation (2), in connection with Fig. 16.

The point where the axis is horizontal may be found from Equation (2), in conjunction with Fig. 17.

The slope at the right end, given by Equation (10), due to the moment, $M$, at the left end causing compression in the top fibers of Fig. 5, may be found from Equation (2) and the data of Fig. 18.

The slope at the right end, given by Equation (11), due to a moment, $M_2$, at the right end causing compression in the top fibers of Fig. 6, may be found from Equation (2) in conjunction with Fig. 18.

The results obtained by the use of Equation (2) are identical with those obtained by the use of Equation (5) in each of the foregoing, and it would appear that Equation 5 is only a special case of Equation (2).

The author's derivation of the theorem of three moments under Case III follows directly from the relations established for the various subdivisions of Case II, and, therefore, may be said to be derived wholly by the use of Equation (2). There are numerous forms of the three-moment equation. In the latter part of 1916, the writer derived, and published,* the following well known three-moment equation as well as several other three-moment equations, by means of the angular rotation of the vertical plane section over any intermediate support of a continuous beam. The derivations referred to and the following are from Equation (2). Let Fig. 19 represent any two adjacent spans of a continuous beam resting on level supports. Let the nature of the supports be such that the beam is without restraint in a longitudinal direction.

Let Fig. 20 show the left span of Fig. 19, on which the forces and moments shown are those existing when this span is acting as a part of the whole beam. In order to find the angular motion of the end planes of this span of the beam, the auxiliary load of unity will be considered to be applied at a unit's distance from the axis.

For determining the angular rotation of the left end, the auxiliary force of unity, and the reactions produced by it, are shown in Fig. 21.

* In the *Polytechnic Engineer* for 1917.

Mr Hudson.

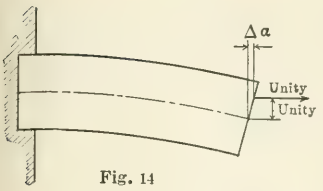


Fig. 14

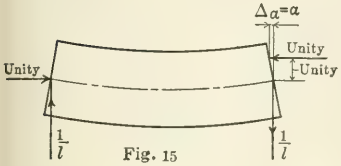


Fig. 15

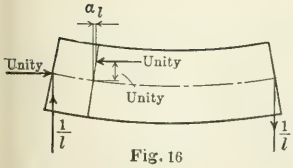


Fig. 16

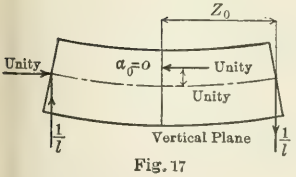


Fig. 17

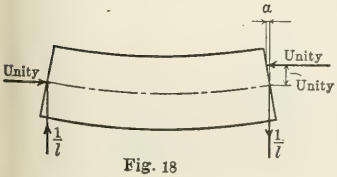


Fig. 18

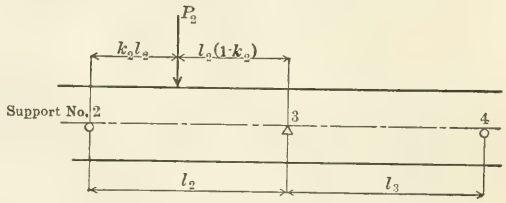


Fig. 19

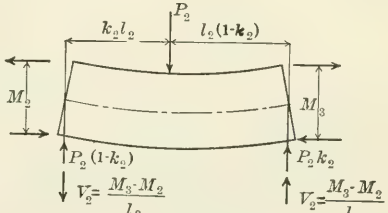


Fig. 20

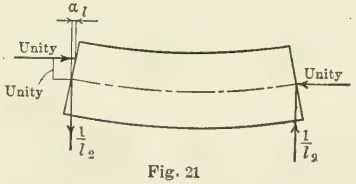


Fig. 21

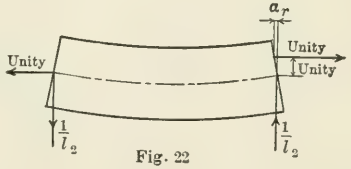


Fig. 22

Mr. Hudson.

The clockwise motion of the left end is:

$$\alpha_{2r} = \int_0^{l_2} -M_2 \left(1 - \frac{x}{l_2}\right) \frac{d\,x}{E\,I_2} + \int_0^{l_2} -\frac{(M_3 - M_2)}{l_2}\, x \left(1 - \frac{x}{l_2}\right) \frac{d\,x}{E\,I_2}$$

$$+ \int_0^{l_2} P_2 (1 - k_2)\, x \left(1 - \frac{x}{l_2}\right) \frac{d\,x}{E\,I_2}$$

$$+ \int_{k_2 l_2}^{l_2} - P_2 (x - k_2 l_2) \left(1 - \frac{x}{l_2}\right) \frac{d\,x}{E\,I_2}$$

$$= \frac{M_2}{E}\left[ - \int_0^{l_2} \frac{d\,x}{I_2} + \int_0^{l_2} \frac{2\,x\,d\,x}{I_2\,l_2} - \int_0^{l_2} \frac{x^2\,d\,x}{I_2\,l_2^2} \right] + \frac{M_3}{E}\left[ - \int_0^{l_2} \frac{x\,d\,x}{I_2\,l_2} \right.$$

$$\left. + \int_0^{l_2} \frac{x^2\,d\,x}{I_2\,l_2^2} \right] + \frac{P_2}{E}\left[ + \int_0^{k_2 l_2} \frac{x\,d\,x}{I_2} + k_2 \int_0^{k_2 l_2} \frac{x\,d\,x}{I_2} - \frac{1}{l_2} \int_0^{k_2 l_2} \frac{x^2\,d\,x}{I_2} \right.$$

$$\left. + k_2\,l_2 \int_{k_2 l_2}^{l_2} \frac{d\,x}{I_2} - 2\,k_2 \int_0^{l_2} \frac{x\,d\,x}{I_2} + \frac{k_2}{l_2} \int_0^{l_2} \frac{x^2\,d\,x}{I_2} \right] \ldots\ldots (D)$$

Fig. 22 shows the auxiliary force of unity, and its reactions, necessary to determine the clockwise motion of the right-end plane which is, in the same manner as before:

$$\alpha_{2r} = \frac{M_2}{E}\left[ \int_0^{l_2} \frac{x\,d\,x}{I_2\,l_2} - \int_0^{l_2} \frac{x^2\,d\,x}{I_2\,l_2^2} \right] + \frac{M_3}{E} \int_0^{l_2} \frac{x^2\,d\,x}{I_2\,l_2^2} + \frac{P_2}{E}$$

$$\left[ - \frac{1}{l_2} \int_0^{k_2 l_2} \frac{x^2\,d\,x}{I_2} + \frac{k_2}{l_2} \int_0^{l_2} \frac{x^2\,d\,x}{I_2} - k_2 \int_{k_2 l_2}^{l_2} \frac{x\,d\,x}{I_2} \right] \ldots\ldots (E)$$

For the right-hand span of Fig. 19, the angular changes of the end planes under the same assumptions as for the left span are:

$$\alpha_{3l} = \frac{M_3}{E}\left[ - \int_0^{l_3} \frac{d\,x}{I_3} + \int_0^{l_3} \frac{2\,x\,d\,x}{I_3\,l_3} - \int_0^{l_3} \frac{x^2\,d\,x}{I_3\,l_3^2} \right] + \frac{M_4}{E}\left[ - \int_0^{l_3} \frac{x\,d\,x}{I_3\,l_3} \right.$$

$$\left. + \int_0^{l_3} \frac{x^2\,d\,x}{I_3\,l_3^2} \right] + \frac{P_3}{E}\left[ + \int_0^{k_3 l_3} \frac{x\,d\,x}{I_3} + k_3 \int_0^{k_3 l_3} \frac{x\,d\,x}{I_3} - \frac{1}{l_3} \int_0^{k_3 l_3} \right.$$

$$\left. \frac{x^2\,d\,x}{I_3} + k_3\,l_3 \int_0^{l_3} \frac{d\,x}{I_3} - 2\,k_3 \int_0^{l_3} \frac{x\,d\,x}{I_3} + \frac{k_3}{l_3} \int_0^{l_3} \frac{x^2\,d\,x}{I_3} \right] \ldots (F)$$

and $$\alpha_{3r} = \frac{M_3}{E}\left[ \int_0^{l_3} \frac{x\,d\,x}{I_3\,l_3} - \int_0^{l_3} \frac{x^2\,d\,x}{I_3\,l_3^2} \right] + \frac{M_4}{E} \int_0^{l_3} \frac{x\,d\,x}{I_3\,l_3^2} + \frac{P_3}{E}$$

$$\left[ - \frac{1}{l_3} \int_0^{k_3 l_3} \frac{x^2\,d\,x}{I_3} + \frac{k_3}{l_3} \int_0^{l_3} \frac{x^2\,d\,x}{I_3} - \frac{k_3}{l_3} \int_{k_3 l_3}^{l_3} \frac{x\,d\,x}{I_3} \right] \ldots\ldots (G)$$

When the beam is acting as a whole, $\alpha_{2r}$ equals $\alpha_{3l}$, as they are angular rotations of the same plane; therefore, we may write the right half of Equation ($E$) equal to the right half of Equation ($F$). Before writing the equation it should be noted that $M_2$, $M_3$, and $M_4$, have

Mr. Hudson.

been used, as shown in Fig. 20, as negative moments, hence their values as determined from any combination of the foregoing equations would be positive. Therefore, it will be best to change the signs of the moments over the supports to make them agree with the general convention. By doing this, there results the following equation of three moments:

$$M_2\left[-\int_0^{l_2}\frac{x\,d\,x}{I_2\,l_2}+\int_0^{l_2}\frac{x^2\,d\,x}{I_2\,l_2}\right]-M_3\int_0^{l_2}\frac{x^2\,d\,x}{I_2\,l_2^2}+M_3\left[-\int_0^{l_3}\frac{d\,x}{I_3}\right.$$

$$\left.+\int_0^{l_3}\frac{2\,x\,d\,x}{I_3\,l_3}-\int_0^{l_3}\frac{x^2\,d\,x}{I_3\,l_3^2}\right]+M_4\left[-\int_0^{l_3}\frac{x\,d\,x}{I_3\,l_3}+\int_0^{l_3}\frac{x^2\,d\,x}{I_3\,l_3^2}\right]=$$

$$-P_2\left[-\frac{1}{l_2}\int_0^{k_2\,l_2}\frac{x^2\,d\,x}{I_2}+\frac{k_2}{l_2}\int_0^{l_2}\frac{x^2\,d\,x}{I_2}-k_2\int_{k_2\,l_2}^{l_2}\frac{x\,d\,x}{I_2}\right]+P_3$$

$$\left[\int_0^{k_3\,l_3}\frac{x\,d\,x}{I_3}+k_3\int_0^{k_3\,l_3}\frac{x^2\,d\,x}{I_3}+k_3\,l_3\int_{k_3\,l_3}^{l_3}\frac{d\,x}{I_3}-2\,k_3\int_0^{l_3}\frac{x\,d\,x}{I_3}\right.$$

$$\left.+\frac{k_3}{l_3}\int_0^{l_3}\frac{x^2\,d\,x}{I_3}\right]\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(H)$$

Equation ($H$) may be used to design or investigate continuous girders having a varying moment of inertia. A somewhat simpler form of Equation ($H$) may be derived by measuring $x$ and $k$ from the left end of the left span and the right end of the right span of the two spans adjacent to any support. The differences in elevation of the supports may readily be included in the foregoing, provided they are small, as it is entirely a matter of geometry.

Case IV is in reality only a repetition of Case II.

Case V is more readily solved by Equation (1) than by Equation (4) as the author shows.

With respect to the remaining cases, suggested for illustration by the author, the writer believes, that Equations (1) and (2) will give simpler solutions than Equation (4), with the possible exception of Case VIII. For the latter, the value of the method can only be determined by considerable investigation, and this the writer has not made.

Mr. Godfrey.

Edward Godfrey,* M. Am. Soc. C. E. (by letter).†—The formula given in Equation (1) is familiarly known as the "Sigma $p\ u\ l$ over $E$" formula, though that equation is not in the same shape as this easily remembered form. In the familiar form it is

$$\Delta=\Sigma\frac{p\ u\ l}{E}$$

where $\Delta$ is the deflection of any point in a frame in a given direction;

* Pittsburgh, Pa.

† Received by the Secretary, April 14th, 1919.

Mr. Godfrey.

$p$ is the stress in any member of the frame due to a load of 1 lb. in that same direction and applied at the same point;

$u$ is the unit stress in the member under its stress;

$l$ is the length of the member;

and $E$ is the modulus of elasticity.

This is a useful equation and the form just given is a simple one to remember and apply. The writer has used it in dealing with drawbridges and hingeless arches, and it is needed for such indeterminate cases.

The author's new formula may also be found useful for indeterminate cases. It might be suggested that it be simplified to the form

$$\alpha = \Sigma \frac{r\ u\ l}{E}$$

where $\alpha$ is the angular rotation in a frame in any point in a given direction;

$r$ is the stress in any member of the frame due to a couple of unity, applied at the point in question, that will tend to give rotation in that same direction;

and the other values are as before.

This could be called the "Sigma $r\ u\ l$ over $E$" formula.

The writer believes there is an error in Equation (7) in which the inclination at the end of a cantilever beam is given as $\frac{P\ l^2}{E\ I}$, and that it should be $\frac{P\ l^2}{2\ E\ I}$.

Although the writer does not question the correctness of the formulas nor the possibilities of their usefulness in a limited way, he thinks that their application to a king-post truss and framed bents, and to secondary stresses from such causes as rotation of members on the pins due to deflection or to rigidity of riveted connections, although interesting as studies in what might be called pure applied mathematics, have no place in practical engineering.

The reason for this is two-fold, and both phases deserve consideration and emphasis. Stating the reasons briefly: (1) Perhaps not one engineer in fifty doing practical designing could follow this paper or apply it in a practical design; (2) There is no reason on earth why it should be applied in a practical design.

Taking these up separately: Is there any reason for not simplifying mathematics so that the average designer can understand and apply it? The writer does not hesitate to state that, if it is a matter of the designing of ordinary construction, the design should be simplified down to the last degree. There are some structures, such as suspension

Mr. Godfrey.

bridges and fixed-ended arches, that come up only once in a long time, and these can be referred to a mathematical expert. Such matters, however, as mill building and truss design are the daily concern of men who have only a limited knowledge of mathematics. They cannot and will not use the higher methods of designing, even if these are required in safe design; and the sad fact is that they will not, and do not, use ordinary common sense at all times, with the result that a large number of poor designs are turned out.

The writer, during the past 25 years, has been in a position in which few men in the Profession are placed, and is able to make the statement in the foregoing paragraph with emphasis. Called on repeatedly, as he is, to check the designs of others, both recent and ancient, he is thoroughly convinced that what designers need is not more complicated mathematical processes, not more mathematics, but, in fact, less mathematics and more common sense in instruction in designing.

The design of a pair of columns supporting a roof truss, with knee-braces, can be made an exceedingly complicated problem. It can be made so intricate that the average designer could not touch it. Only an expert, and that expert devoting many hours to the problem, could run out all the possibilities of stress of this simple piece of construction. The building would not stand the cost of engineering of this class. Here is the economic situation. What is the outcome? The complex treatment is thrown to the winds, and the truss and columns are designed by rule-of-thumb, and bad rule at that. The columns are designed for direct load only, with no regard to bending moments or wind loads. Frequently, no knee-braces whatever are used, and a flimsy and wabbly building results.

On the other hand, the solution of this mill building problem can be rendered as simple as an ordinary truss design by ignoring trivial theoretical matters, by dividing equally between the columns the horizontal force of the wind, and computing the force in the knee-braces and the truss from these applied loads; and a building designed in this manner is both economical and perfectly safe. The average designer can grasp this method quite readily; but our books and engineering literature delight in investing this problem with the greatest complexity, with the result that the majority of designers do not even attempt to approximate its solution, and bad structures grow out of this condition of affairs.

If a fraction of the space taken up with fancy solutions of the mill building problem was devoted to some common-sense simple methods of getting the stresses approximately, and some homely advice was given on how to detail parts, the Profession would be much better off. For example, the writer wished to find (for the head of an engineering school) the details of a mill building where the chords intersect

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over the support, as an example of good practice in detailing. A thorough search, and inquiry among bridge firms, failed to secure a single case.

As to the question of the need of these higher theories, the mere fact that they are ignored habitually in the design of mill buildings does not argue one way or the other. It is notorious that mill buildings are poorly designed. Much other structural designing is also poor, not because finer theories are neglected, but because common sense is not exercised. The writer would never dream of applying the theory of secondary stresses to a building or bridge, but he has found errors by the hundred, in both design and detail, that would not be possible if designers were instructed in the simple rudiments of proper design that require a knowledge of nothing but the simplest mathematical processes and ordinary mechanics. It is not important for a designer to find that a detail needs 21.1 rivets or 21.3 rivets, but, when a design is turned out and has 11 rivets where about 21 are required, something should be done that will put that designer on the right track.

The members of a cantilever bracket may intersect in the exact center of a truss, just as theory may dictate, and still the bracket may be dependent on the tension in the heads of three or four rivets. This is higher theories with a vengeance!

If steel was perfectly elastic and perfectly brittle, like glass, higher theories would be appropriate and no doubt necessary. Then secondary stresses would loom large in all design. The great Firth of Forth Bridge would then be one of the most dangerous bridges in the world, because of the great secondary stresses due to deflection; but, because steel is tough and not perfectly elastic, that bridge is one of the safest in existence. The tubular members and the rigidly riveted details are the very things that make it so safe, and they are the very things that, theoretically, add tremendously to the stresses. Will engineers ever get this idea?

It is a strange coincidence that the Royal Commission that investigated the Quebec Bridge failure attributed its weakness to the fact that the connections of the compression members were not riveted up. The condition for creating secondary stresses was absent. The same Royal Commission ignored the big traveler, which, being without bracing, upset and pulled the bridge over with it. It does not take even a knowledge of algebra to understand this glaring error.

The Orpheum Theater, in New York City, collapsed, and, in all the reports of its failure, the real cause was ignored. This was a monstrous curved girder, with a span of 74 ft. and a versed sine of 12 ft., connected at the ends to the corners of slender columns.* Among the theories advanced to account for the failure was one, from across the ocean, that attributed it to the twisting in a supporting girder due to

* *Engineering and Contracting,* February 18th, 1914.

deflection of the cross-girders. This is the very limit. It is the theory of secondary stresses carried to its logical limit of absurdity. It is hard to think of anything more misleading and harmful than this kind of theoretical camouflage, not because theoretical speculation in itself is harmful, but because it obscures the facts and takes up space that might be devoted to constructive knowledge of a simple character. Mr. Godfrey.

The foregoing instances are given, not because the writer would deprecate the value of theory in engineering design, but would elevate it to a position of usefulness, pure and simple. He would remove it from the condition where it is virtually merely an academic plaything, applied where it has no meaning whatever, and applied on premises of properties of materials that do not exist in fact. He would make theory agree with facts as they are, and not with conceptions of what might exist if steel and concrete had other properties than they are known to possess; and, lastly, he would simplify theory, so that it is understandable on the part of the men who use it.

Irving P. Church,* Assoc. Am. Soc. C. E. (by letter).†—The writer has been much interested in examining this paper with a view to ascertaining to what extent it supplements the principles and methods proved and exemplified by Castigliano in his classic book‡ on elastic framed systems, or mechanics of the "work of elastic deformation", or of "internal work", as it might also be called. Mr. Church.

A very brief résumé of the main theorems proved by Castigliano, therefore, will be undertaken; the elastic framed structure in question being a jointed assemblage of bars and beams (straight or curved), fitted together originally without strain, with the axes of all members lying in a common vertical plane (plane of loading), and with all cross-sections of members symmetrical about that plane.

The notation will be that of the author, with a few supplementary symbols.

Let $U$ denote the total work of elastic deformation (*i. e.*, "internal work") of the frame when loaded. Then, omitting the work of shear, as of very slight consequence, we have

$$U = \sum \int \frac{T_s^2 \, dl}{2EA} + \sum \int \frac{M_s^2 \, dl}{2EI} \quad \ldots\ldots\ldots\ldots (24)$$

Also, the deflection (displacement) of any point of any member, or of a joint, at which point or joint a load or force, $P$, is applied, this deflection being that taking place in the direction of the line of action of such force or load, will be given by the relation

* Ithaca, N. Y.

† Received by the Secretary, April 16th, 1919.

‡ This book, by A. Castigliano, is entitled "Théorie de l'Equilibre des Systèmes Elastiques", and was published at Turin in 1879.

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$$\Delta = \frac{d\,U}{d\,P} = \sum \int \frac{T_s}{E\,A}\left(\frac{d\,T_s}{d\,P}\right) d\,l + \sum \int \frac{M_s}{E\,I}\left(\frac{d\,M_s}{d\,P}\right) d\,l \ldots (25)^*$$

The first term in the right-hand member of Equation (25) is of a general form, so as to provide, not alone for straight bars in which there is direct stress only, but also for bars or beams in which, or in portions of which, $T_s$ or $A$ may not be constant along the length.

For a frame of ordinary straight bars under direct stress of tension or compression, as in a pin-connected bridge truss, Equation (25) reduces to

$$\Delta = \sum \frac{T_s\,l}{E\,A}\left(\frac{d\,T_s}{d\,P}\right) \ldots\ldots\ldots\ldots\ldots\ldots (26)$$

Similarly, the change of slope, or angular rotation, due to the loading, of the straight line joining any two points of the frame (not joints necessarily) where there are applied two equal parallel forces forming a couple, of moment $M$, the two forces being at right angles to that line, which is, therefore, the "arm" of the couple, is determined by the relation

$$\alpha = \frac{d\,U}{d\,M} = \sum \int \frac{T_s}{E\,A}\left(\frac{d\,T_s}{d\,M}\right) d\,l + \sum \int \frac{M_s}{E\,I}\left(\frac{d\,M_s}{d\,M}\right) d\,l \ldots (27)$$

(See foot-note following Equation (25)).

Castigliano goes on to treat the case of a frame containing one more bar than is necessary for the frame to hold its shape; this "superfluous", or "redundant", bar being pin-connected at its extremities and of such length that it is too short, or too long, by a small amount, $\lambda_0$, to fit into its place after the "necessary" members have been assembled without loading; so that, to fit it into place, special constraint must be exerted. After this "redundant" bar is in place and the frame is loaded, the special constraint having been removed, the direct stress, $T'$ produced in the bar (which carries no load along its length) is found by the relation

$$\frac{d\,U}{d\,T'} = \lambda_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (28)$$

Hence, it follows, as a particular case, that, when the "redundant bar" has just the proper length to fit into place originally without strain, the direct stress, $T$, induced in it when the loading is in position, is determined by the equation

$$\frac{d\,U}{d\,T} = 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

* A very important restriction on the use of Equation (25), and the other fundamental relations to follow, is that the supporting forces (or reactions) acting on the frame must be "neutral"; that is, the point of application of each such force must not move during the gradual application of the loading, unless along a line at right angles to the line of action of such force.

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This has been called the principle of "least work"; as it may easily be proved, by the consideration of a curve (parabola with axis vertical), plotted with $U$ for ordinate and $T$ (as variable) for abscissa, that the special value of $T$ found from Equation (29) is the abscissa of the lowest point of the curve, where the tangent line is horizontal, and, consequently, the corresponding value of $U$ is less than for any other (tentative) value of $T$.

For finding the deflection, in a given direction, of a point in the frame where there is no load, or at least no load acting in the desired direction, Castigliano uses the device of inserting an imaginary load, $P_0$, at the point in question and in the desired direction; and later reduces it to zero (as, of course, must finally be done, for correct results). This auxiliary load or force, $P_0$, which may be called a "dummy" load, and is treated as a variable, will enter more or less into the expressions for $T_s$ and $M_s$, the differentiation of which expressions with respect to $P_0$ will give the derivatives, $\left(\frac{d\,T_s}{d\,P_0}\right)$ and $\left(\frac{d\,M_s}{d\,P_0}\right)$. Now, these derivatives will not contain $P_0$, because, for ordinary frames, only the first power of $P_0$ can occur in any term of the expressions for $T_s$ and $M_s$, and hence are not affected when the value of $P_0$ is made zero. Equation (25) is then used for finding the deflection, with $P_0 = 0$; that is, by substituting in it the foregoing values of the derivatives together with the values of $T_s$ and $M_s$, as determined from the actual loading alone, $P_0$ being omitted. Hence, in this case of the "dummy" load, $P_0$, we have

$$\Delta = \frac{d\,U}{d\,P_o} = \sum\int \frac{T_s}{E\,A}\left(\frac{d\,T_s}{d\,P_0}\right) d\,l + \sum\int \frac{M_s}{E\,I}\left(\frac{d\,M_s}{d\,P_0}\right) d\,l \ldots (30)$$

Now $\frac{d\,T_s}{d\,P_0}\left(\text{or } \frac{d\,M_s}{d\,P_0}\right)$ is the rate at which $T_s$ (or $M_s$) varies with respect to $P_0$, a rate of so many pounds (or foot-pounds) per pound of $P_0$; and furthermore, as $T_s$ (or $M_s$) is a straight-line function of $P_0$ (for ordinary "engineering" frames), the value of the rate, $\frac{d\,T_s}{d\,P_0}$, $\left(\text{or } \frac{d\,M_s}{d\,P_0}\right)$, which represents "the slope" of the straight line, is numerically the same as the hypothetical value that $T_s$ (or $M_s$) would have if $P_0$ were the only load and had a value of unity.* These hypothetical values may be called $T_1$ and $M_1$, respectively. Hence a ready way of expressing the values of the two derivatives, $\frac{d\,T_s}{d\,P_0}$ and $\frac{d\,M_s}{d\,P_0}$, is to write out what $T_s$ and $M_s$ would be if a unit load were applied at the point in question and in the desired direction,

* Or, to put it another way, the finite change or increment of $T_s$ (or $M_s$) due to the introduction of $P_0$ among the loads is proportional to $P_0$.

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with no other load on the frame. With this change of notation, therefore, Equation (30) becomes

$$\Delta = \sum \int \frac{T_s\, T_1}{E\, A} \cdot d\, l + \sum \int \frac{M_s\, M_1}{E\, I} \cdot d\, l \ldots\ldots\ldots (31)$$

(Castigliano does not use the device of a unit load for finding deflections. It was discovered and adopted independently by the author of the present paper in America and by Fraenkel in Europe.)

Castigliano not only uses the device of a "dummy" load for finding deflections, but also that of an imaginary, or "dummy", couple, of moment, $M_0$ (say), applied to the free extremity of a beam in order to find the change of slope, due to the loading, of the tangent to the elastic curve of the beam at that extremity, there being no actual couple at that point. $M_0$ is finally reduced to zero. As in the previous case of the "dummy" load, $T_s$ and $M_s$ are expressed in terms of $M_0$ and the other loading, so that the derivatives, $\frac{d\, T_s}{d\, M_0}$ and $\frac{d\, M_s}{d\, M_0}$, may be determined. According to Equation (27) the formula for the change of slope (or rotation) at that point, with the couple in place, is

$$\alpha = \frac{d\, U}{d\, M_0} = \sum \int \frac{T_s}{E\, A} \left(\frac{d\, T_s}{d\, M_0}\right) d\, l + \sum \int \frac{M_s}{E\, I} \left(\frac{d\, M_s}{d\, M_0}\right) d\, l \ldots (32)$$

and when, in this relation, $M_0$ is made equal to zero, the derivatives retain their values unchanged, while $T_s$ and $M_s$ assume the values proper to them under the actual loading alone, the couple having been removed. As before, as $T_s$ and $M_s$ are almost invariably straight-line functions of $M_0$, the numerical values of these derivatives are equal, respectively, to the values that $T_s$ and $M_s$ would have if the "dummy" couple had a moment equal to unity and constituted the sole loading on the frame or beam. Hence, these derivatives become the $T_r$ and $M_r$, respectively, of the paper, and the result will now read

$$\alpha = \sum \int \frac{T_s\, T_r}{E\, A}\, d\, l + \sum \int \frac{M_s\, M_r}{E\, I} \cdot d\, l \ldots\ldots\ldots (33)$$

which is the author's Equation (6). This equation is given and proved by Müller-Breslau* in connection with straight and curved beams. He makes very little use of it, however.

In his treatment of single beams, Castigliano rarely finds occasion to use a "dummy" couple, to determine the rotation of a tangent line of the elastic curve; because, when any cross-section forms the extremity of a portion of the beam, considered as a complete beam or frame in itself, apart from the remainder (as, for instance, in dealing with the continuous girder), the flexural couple of the cross-section becomes a

* It is Equation (54a) on p. 133 (see also pp. 69 and 205) of his work entitled: "Die neueren Methoden der Festigskeitslehre und der Statik der Baukonstruktionen," Leipsic, 1893, this equation containing also terms for dealing with a possible change of temperature and slight movement of supports.

part of the external loading for that portion, and is used by Castigliano in expressing the change of slope at that section; in other words, no "dummy" couple is needed in such a case. Mr. Church.

By way of a comparative showing of these three methods for finding the change of slope, or rotation, of a tangent line at a definite point of a loaded beam, take the simple case of a straight elastic prismatic beam, fixed horizontally at the left-hand end and loaded at the other (free) extremity with a vertical load, $P$, and determine the rotation, $\alpha$, of the tangent at the midway point of the length, from its original horizontal position.

*First Method. Dummy Couple.—Fig. 23.*—Conceive a rigid straight bar, with its axis following the tangent in question, to be fastened to the beam at the point, $B$, by two bolts very near together, and a couple, of moment $M_0$, to be applied to it, this couple being right-handed, so as to tend to produce a value of $\alpha$ of the same character as that due to the load, $P$. This bar forms an additional member of the elastic system, and two consequences follow from its being rigid: (1) its axis will remain straight during the gradual loading, always coinciding with the tangent at $B$, so that the rotation of this "arm" of the couple is the same as that of the tangent; (2) the "internal work" of the bar is zero, so that no terms are needed in Equation (32) to cover the deformation of the bar (that is, its $E$ is infinite).

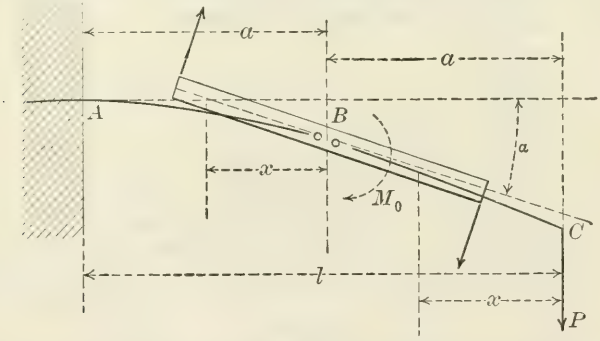


FIG. 23.

In Equation (32), therefore, we have: For the elements of length, $dx$, along the portion, $BC$:

$$T_s = 0; \text{ whence } \frac{d\,T_s}{d\,M_0} = 0;$$

$$M_s = -Px; \text{ whence } \frac{d\,M_s}{d\,M_0} = 0;$$

and along the portion, $A\,B$:

$$T_s = 0; \text{ whence } \frac{d\,T_s}{d\,M_0} = 0;$$

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$$M_s = -P\,(a + x) - M_0;\ \text{whence}\ \frac{d\,M_s}{d\,M_0} = -1.$$

Hence, making $M_0 = 0$ and substituting in Equation (32),

$$\alpha = 0 + 0 + 0 + \frac{1}{E\,I}\int_0^a [-P\,(a + x)]\,(-1)\,d\,x \ldots\ldots (33)$$

that is,

$$\alpha = \frac{P}{E\,I}\left(a^2 + \frac{a^2}{2}\right) = \frac{3}{2}\cdot\frac{P\,a^2}{E\,I} \ldots\ldots\ldots\ldots (34)$$

$$\text{or, as } a = \frac{1}{2}\,l,$$

$$\alpha = \frac{3}{8}\cdot\frac{P\,l^2}{E\,I};$$

as may easily be found by more elementary methods.

*Second Method. Utilizing an Internal Couple.—Fig. 24.*—The internal couple, or flexural couple, at section $B$ has a moment we may call $M_B$, and if the portion, $AB$, of the beam is considered as a complete elastic system in itself ("free body"), the couple becomes an external couple, as this couple and the vertical shear, $J_B$, of the section constitute a loading representing the action of the part, $BC$, conceived as removed, upon the extremity, $B$, of the portion remaining, $AB$, now considered in Fig. 24. The flexural couple and shear at $A$ play the part of supporting forces, but their points of application do not move, and this fact justifies the use of Castigliano's theorems.

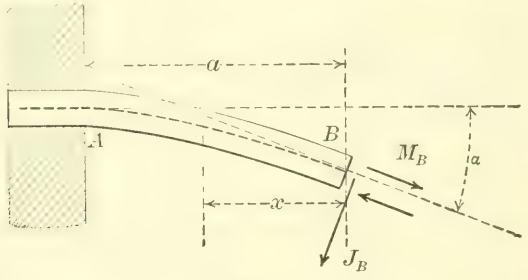


FIG. 24.

(Equation (27) could not be applied to the portion, $BC$, considered by itself, for finding $\alpha$, because, of the four forces acting on that portion, no three, viewed as supporting forces, have motionless points of application. See foot-note following Equation (25)).

For the $dx$'s along $AB$, we have

$$T_s = 0;\ \text{whence}\ \frac{d\,T_s}{d\,M_B} = 0;$$

$$M_s = -J_B\,x - M_B;\ \text{whence}\ \frac{d\,M_s}{d\,M_B} = -1$$

and hence Equation (27) gives

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$$\alpha = 0 + \frac{1}{EI}\int_0^a [-J_B x - M_B](-1)\, dx \ldots\ldots\ldots (35)$$

but $M_B = Pa$, and $J_B = P$, and, therefore $\alpha = \frac{3}{2} \cdot \frac{Pa^2}{EI}$, as before.

*Third Method. Using an Imaginary Couple of Moment Equal to Unity.—Fig. 25.*—Conceive a rigid cross-bar bolted to the beam at section $B$, and consider a couple applied to it of moment equal to — 1 (minus, in order to have it in the same "sense" as the rotation, $\alpha$, at $B$), this being for the sole purpose of determining $T_r$ and $M_r$ for the successive infinitesimal lengths, $dx$, along the whole beam, for use in Equation (33).

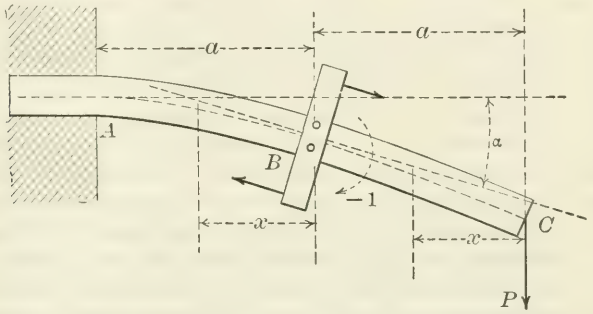


Fig. 25.

For any $dx$ along $BC$

$$T_s = 0; \qquad T_r = 0;$$
$$M_s = -Px; \qquad M_r = 0;$$

and for any $dx$ along $AB$

$$T_s = 0; \qquad T_r = 0;$$
$$M_s = -P\ (a + x); \quad M_r = -1;$$

and hence substitution in the author's Equation (6) or Equation (33) of this discussion, gives

$$\alpha = 0 + 0 + 0 + \frac{1}{EI}\int_0^a [-P(a + x)](-1)\, dx. \ldots. (36)$$

$$\text{or } \alpha = \frac{3}{2} \cdot \frac{Pa^2}{EI}$$

In conclusion, it would appear that, in finding the rotation of a tangent line, there is in many cases a decided advantage in using the device of a couple with a moment of unity, so far as the shortening of the routine work is concerned; and the author has rendered an important service in the publication of this paper, with its very direct and convincing proof and numerous applications.

Mr. Parcel.

JOHN I. PARCEL,* ESQ. (by letter).†—The author has presented a clear and complete exposition of the rotational work equation, and some very interesting applications, notably the beautifully direct and simple derivation of the three-moment theorem in its general form.

The paper adds another to the many illustrations of the fact that widespread knowledge and full appreciation of new principles in the theory of structures frequently lags considerably behind their discovery. This seems to have been true regarding the "general work equations,"‡ the principle of "moment areas"§ (its advocates assert that its scope and importance is still but half appreciated by the profession generally), and the so-called "slope-deflection" method‖, which has recently yielded elegant solutions of certain problems in rigid frames.

In so far as Professor Swain's new principle consists in expressing the angular movement at a given point in the axis of a bar by the method of work, in a manner analogous to that for linear movement, it is not new. English and American treatises¶ on the theory of structures, as a rule, give a very restricted and inadequate presentation of the "method of work." German (and other continental European) treatises, however, lay considerable stress on the generality of the work equations, noting that $\Delta$ (to follow the notation of the author's Equations (1) and (2)) is linear or angular displacement, according as the "unit loading" which produces $t$ and $Mt$ is a unit force or a unit couple. Some of these works develop equations similar to the author's Equation (6), and give elementary examples of the calculation of angular change;** but the principle seems to be little understood (or at least little appreciated) generally, and Professor Swain has rendered no small service to the profession by his excellent presentation.

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† Received by the Secretary, April 19th, 1919.

‡ First stated in their general form by O. Mohr (1874), who also seems to have been the first to realize their vast importance in the analysis of structures. The essential features of Mohr's method, however, were anticipated (according to Müller-Breslau) by Maxwell (1864), and the fundamental principle was enunciated by Clapeyron in 1833.

§ Generally ascribed to Mohr (1868), but developed independently in a somewhat different form by the late Charles E. Greene, M. Am. Soc. C. E. (1874). Its wide use in America is of comparatively recent date.

‖ Applied by Mohr to the secondary stress problem as early as 1891 (*Zivilingenieur*, 1892, p. 577), but attracting little attention for many years. Presented as a general method of attack for a variety of problems in rigid frames by G. A. Maney ("Studies in Engineering, No. 1," University of Minnesota, 1915).

¶ See, however, D. A. Molitor, M. Am. Soc. C. E., "Kinetic Theory of Engineering Structures", pp. 18 and 28–29. The exposition is much less complete than in the references cited below.

** See, especially, F. Hartmann, "Die Statisch Unbestimmten Systeme des Eisen und Eisen-betonbaues" (1913), pp. 9–11 and 24–33; also G. C. Mehrtens, "Statik und Festigkeitslehre" (1910), pp. 203–204 and 215 *et seq.*; H. F. B. Mueller-Breslau, "Die Graphische Statik der Baukonstruktionen", Band II, Erste Abtheilung (1903), pp. 14–17; and "Die Neueren Methoden der Festigkeitslehre" (1904), pp. 59 and 84–85. Mueller-Breslau seems to claim for himself the honor of the discovery of Professor Swain's new principle (see his "Graphische Statik", above cited, pp. 52–57). He states that in the 1886 edition of his "Festigkeitslehre", he first showed that the work equations (which he calls Maxwell's equations) apply to "rotation" as well as "translation."

Mr. Mensch.

L. J. MENSCH,* M. AM. SOC. C. E. (by letter).†—The principle of virtual displacements is one of the most general laws of equilibrium, and in it are contained the theory of least work, Maxwell's and Betti's reciprocal theorems, and Professor Swain's principle. These various rules are either identical or differ only in algebraic expressions of force, moment, and displacement.

The principle of virtual displacements says: The work performed by the exterior forces and reactions when acting on a structure in a state of equilibrium equals the work done by the interior forces in deforming the structure, which principle can be written in the form

$$\Sigma P \cdot \Delta = \Sigma T_s \cdot \Delta d l + \Sigma M_s \cdot \Delta d \alpha \ldots\ldots\ldots\ldots (1)$$

where $P$ denotes the exterior forces and reactions;

$\Delta$ denotes their corresponding displacements at the point of application in the direction of the forces;

$\Delta dl$ denotes the change of length of the length, $dl$, due to the normal forces, $T_s$, produced in the structure by the forces, $P$;

and $\Delta d\alpha$ denotes the change of angle of an element, $dl$, due to the moments, $M_s$, produced in the structure by the forces, $P$.

All expressions are in the familiar shape: Work equals force multiplied by displacement in the direction of the force; and the correctness of Equation (1) appears to be very plausible.

Clapeyron has shown that the actual work performed by gradually applied forces must be half of that above given, and the validity of Equation (1) is not changed by dividing each side by 2. Clapeyron has also shown that the validity of Equation (1) is not changed, when we substitute

First: for the forces and reactions, $P$, another set of forces, $P'$, and their corresponding reactions, as long as the second set of forces and reactions hold the structure in a state of equilibrium; and

Second: The new forces, $T'$, and the new moments, $M'$, produced by the new set of forces and reactions, $P'$, the displacements and deformations of the first set of forces being retained in Equation (1).

The new equation may be written

$$\Sigma P' \cdot \Delta = \Sigma T' \cdot \Delta d l + \Sigma M' \cdot \Delta d \alpha \ldots\ldots\ldots\ldots (2)$$

The new forces, $P'$, and the new stresses, $T'$ and $M'$, have evidently nothing to do with, and are entirely independent of, $\Delta$, $\Delta dl$, and $\Delta d\alpha$, of the first set of forces; their only co-relation is that each set belongs to a state of equilibrium; $\Delta$, $\Delta dl$, and $\Delta d\alpha$, therefore, are called possible or

* Chicago, Ill.

† Received by the Secretary, April 23d, 1919.

Mr. Mensch.

virtual displacements. This is easily proved in the case of the simple structure shown in Fig. 26, consisting of three bars, supported at $A$ and $B$ and affected by a load, $P$, at $C$. The three bars undergo certain elongations and shortenings, producing a definite displacement at $C$. It is clear that any other load will produce stresses and displacements which are in direct proportion to the values of the two loads; and a load of $\frac{P}{2}$, for example, will produce half the stresses and half the changes of length, and also only half the displacement at $C$. For this case Equation (1) may be written, also, in the form

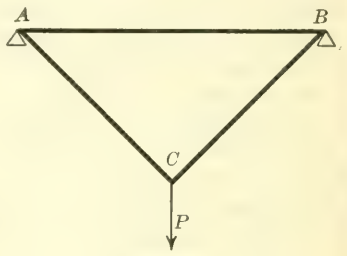

FIG. 26.

$$\Sigma \frac{P}{4} \Delta = \Sigma \frac{T_s}{4} . \Delta d l.$$

$\frac{P}{4}$ and $\frac{T}{4}$ may be considered as new forces and stresses which are in a state of equilibrium, and $\Delta$ and $\Delta dl$ are the old displacements. It was soon found that $P$, in Equation (1), and $P'$ in Equation (2) are not necessarily forces, but may be moments, the latter being nothing else than a couple of equal forces acting at a distance, $o$, for example. We can say

$$M = P . o; \quad \Delta = o . \alpha; \quad M = P . \frac{\Delta}{\alpha}; \quad M . \alpha = P . \Delta \ldots\ldots (3)$$

and Equations (1) and (2) become

$$\Sigma M . \alpha = \Sigma T_s . \Delta d l + \Sigma M_s . \Delta d \alpha \ldots\ldots\ldots\ldots (4)$$

$$\Sigma M' . \alpha = \Sigma T' . \Delta d l + \Sigma M' . \Delta d \alpha \ldots\ldots\ldots\ldots (5)$$

which equations express Professor Swain's idea in another form. Maxwell has deduced from Equation (2) a reciprocal theorem, relating to the effect produced in a structure by two different forces:

"A force, 1, in a point, $A$, of a structure in a state of equilibrium, will produce in any other point, $B$, of the same structure, a displacement, $d_{ba}$, which is equal to the displacement, $d_{ab}$, in the point, $A$, in the direction of the first force, 1, produced by another force, 1, acting in $B$ in the direction, $d_{ba}$."

A more general theorem is due to Betti. Müller-Breslau claims that he has first shown that Maxwell's principle can also be applied to moments and to changes of angles, namely: "A moment, 1, acting in any point, $A$, produces a rotation in any point, $B$, which is equal to the rotation produced in $A$ by a moment, 1, acting in $B$", which is, again, Professor Swain's principle expressed in another way.

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Equations (2) and (5) can be transformed into a more useful shape by substituting

$$\Delta\, d\, l = \frac{T_s}{E\, A} \cdot d\, l \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$\Delta\, d\, \alpha = \frac{M}{E\, I} \cdot d\, l \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

thus obtaining

$$\Sigma\, P' \cdot \Delta = \Sigma\, \frac{T_s \cdot T' \cdot d\, l}{E\, A} + \Sigma\, \frac{M_s \cdot M' \cdot d\, l}{E\, I} \quad \ldots\ldots\ldots (8)$$

$$\Sigma\, M' \cdot \alpha = \Sigma\, \frac{T_s \cdot T' \cdot d\, l}{E\, A} + \Sigma\, \frac{M_s \cdot M' \cdot d\, l}{E\, I} \quad \ldots\ldots\ldots (9)$$

Replacing the moments, $M'$, in Equation (9) by only one moment of the value, 1, and by its proper reactions, and under the assumption that the supports are immovable in the direction of these reactions, so that the work of the reactions is nil, then, and then only, Equation (9) becomes

$$\alpha = \Sigma\, \frac{T_s \cdot T' \cdot d\, l}{E\, A} + \Sigma\, \frac{M_s \cdot M' \cdot d\, l}{E\, I} \quad \ldots\ldots\ldots (10)$$

where $T'$ and $M'$ are the normal forces and moments produced in the structure by the moment, 1, and its reactions, which equation is identical with the author's Equation (6).

Similarly, Equation (8) is transformed by the assumption of only one force, 1, acting on a structure with immovable supports in the direction of the reactions

$$\Delta = \Sigma\, \frac{T_s \cdot T' \cdot d\, l}{E\, A} + \Sigma\, \frac{M_s \cdot M' \cdot d\, l}{E\, I} \quad \ldots\ldots\ldots (11)$$

$T'$ and $M'$ being the normal forces and moments produced by the force, 1, and its reactions.

Castigliano has deduced, from the principle of virtual displacements, another rule for finding the displacement of any point of a structure. He replaced the set of forces in Equation (1) by another set of forces which varied from the first only in this respect, that all forces of the old set remained the same except that the force, $P_n$, acting in the point, $n$, the displacement of which is to be found, is changed by the infinitesimal quantity, $\delta\, P_n$. The interior forces will then be changed, also, by the infinitesimal values, $\delta\, T_s$ and $\delta\, M_s$.

Provided the work of the reactions due to $\delta\, P_n$ is nil, Equation (1) becomes

$$\Sigma\, P \cdot \Delta + \delta\, P_n \cdot \Delta_n = \Sigma\, (T_s + \delta\, T_s) \cdot \Delta\, d\, l + \Sigma\, (M_s + \delta\, M_s) \cdot \Delta\, d\, \alpha \quad (12)$$

Subtracting Equation (1) from Equation (12) and dividing by $\delta\, P_n$

$$\Delta_n = \Sigma\, \frac{\delta\, T_s}{\delta\, P_n} \cdot \Delta\, d\, l + \Sigma\, \frac{\delta\, M_s}{\delta\, P_n} \cdot \Delta\, d\, \alpha$$

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Introducing again Equations (6) and (7)

$$\Delta_n = \Sigma \frac{\delta T_s}{\delta P_n} \cdot \frac{T_s \cdot d l}{E A} + \Sigma \frac{\delta M_s}{\delta P_n} \cdot \frac{M_s \cdot d l}{E I} \quad \ldots\ldots\ldots (13)$$

and, similarly, for moments,

$$\alpha = \Sigma \frac{\delta T_s}{\delta M_n} \frac{T_s \cdot d \alpha}{E A} + \Sigma \frac{\delta M_s}{\delta M_n} \frac{M_s \cdot d l}{E I} \quad \ldots\ldots\ldots (14)$$

These equations are practically identical with Equations (10) and (11), as will be shown later.

Evidently,

$$T_s \cdot \frac{\delta T_s}{\delta P_n} = \frac{\delta T_s^2}{2 \delta P_n},$$

$$M_s \cdot \frac{\delta M_s}{\delta P_n} = \frac{\delta M_s^2}{2 \delta P_n}$$

hence Equations (13) and (14) become

$$\Delta_n = \frac{\delta \left\{ \Sigma \frac{T^2 d l}{2 E A} + \Sigma \frac{M^2 d l}{2 E I} \right\}}{\delta P_n} \quad \ldots\ldots\ldots (15)$$

$$\alpha = \frac{\delta \left\{ \Sigma \frac{T^2 \cdot d l}{2 E A} + \Sigma \frac{M^2 \cdot d l}{2 E I} \right\}}{\delta M_n} \quad \ldots\ldots\ldots (16)$$

The expressions in the denominator are those of Clapeyron for the actual work performed by gradually applied forces acting on a structure in equilibrium, and Equations (13) to (16) simply state that the displacement or the rotation of a point, $n$, acted on by a force, $P_n$, or a moment, $M_n$, equals the first partial derivative of the expression for the work of the gradually produced interior forces, taken according to $\delta P_n$ or $\delta M_n$.

At an immovable support, $\Delta$ or $\alpha$ must be nil, hence the first derivative must be zero. This can only happen for a condition where the work is a maximum or a minimum. It can be easily shown that the work cannot be a maximum, hence it must occur at a minimum. Therefore, Equations (13) to (16) have been called the principle of least work. If it is desired to find the displacement of any point at which no force happens to act, it is assumed that a fictive force or moment is acting at that point, $P_n$ or $M_n$; the general expressions for the work performed by all the forces and moments and $P_n$ and $M_n$ are written down, the first derivative is found, and in this derivative and the general equation of the moment, $P_n$ and $M_n$ are assumed to vanish. The normal forces and moments produced in any structure by a single

load or moment, being always linear functions of $P_n$ or $M_n$, it follows that $\frac{\delta T}{\delta P_n}$ and $\frac{\delta M}{\delta M_n}$ are, in fact, the values of the normal forces and moments corresponding to $P_n = 1$ and $M_n = 1$. Mr. Mensch.

In applying any of these methods to actual structures, great care must be taken first to transform an indeterminate structure into a so-called statically determinate system by the assumption of the proper reactions or forces; one must always consider that the reactions count just as heavily as any other force, and that any movement of the abutments will contribute to the work performed by the exterior forces and must appear on the left side of Equations (1) to (16). If, for example, one abutment has a displacement, $e$, in the direction opposite to the reaction, $R$, and a rotation, $t$, in the direction of the moment of the reaction, $O$, then there must be added to the left of:

Equation (1) $- R \cdot e + O \cdot t$

(10) $- R' \cdot e + O \cdot t$, when $R'$, $V$, and $O$ are the reactions due to $P' = 1$ and $M' = 1$,

(13) and (15) $- \frac{\delta R}{\delta P_n} \cdot e + \frac{\delta O}{\delta P_n} \cdot t$

(14) " (16) $- \frac{\delta R}{\delta M_n} \cdot e + \frac{\delta O}{\delta M_n} \cdot t$

To show that the theory of least work is practically identical with the author's principle, his Case II will be solved by that principle, and it will be assumed that a moment, $M_n$, instead of a moment, 1, is acting at the right end of the beam; then, evidently,

for the left of $P \ldots M_s = P \cdot x \cdot \frac{(l-a)}{l} + M_n \cdot \frac{x}{l} \left\| \frac{\delta M_s}{\delta M_n} = \frac{x}{l} \right\| M_n = 0$ in $M_s$

" " right of $P \ldots M_s = P \cdot a \cdot \frac{l-x}{l} + M_n \cdot \frac{x}{l} \left\| \frac{\delta M_s}{\delta M_n} = \frac{x}{l} \right\| M_n = 0$ " $M_s$

and this, introduced in Equation (14), gives

$$\alpha = \int_0^a \frac{x}{l} \cdot \frac{P\,x\,(l-a)}{l}\,dx + \int_a^l \frac{x}{l}\,P \cdot a \cdot \frac{l-x}{l}\,dx \ldots\ldots$$

which is identical with Professor Swain's Equation (9).

Nothing is saved in the integrations, but Professor Swain saves the writing down of two expressions affected by $\delta M_n$.

If it is desired to find the displacement and rotation of a point of a fixed arch, and if the same method is used as that shown in the author's Case II, it would lead to rather long formulas.

By a happier choice, of transforming the indeterminate structure into a statically determinate system, very much simpler expressions

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can be obtained. Fig. 27 shows how the arch may be transformed into a cantilever by assuming that, at the point, $B$, where the displacement is to be found, the right end of the arch is cut off, and at that section a horizontal force, a vertical force, and a moment, are applied to re-establish the equilibrium. In order to find the displacements by Professor Swain's principle, there is applied, besides, a horizontal and a vertical force, 1, at that section, and a moment, 1, and these new forces must be counterbalanced by the proper reactions at the left abutment.

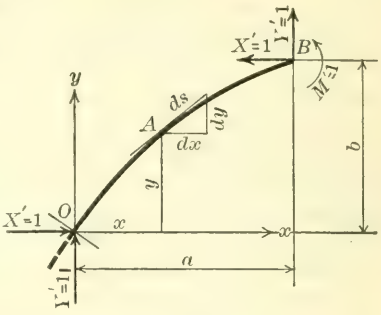


FIG. 27.

$M_s$, at any point, $x$, $y$, is again the moment of the forces acting on the structure the deflection of which it is desired to find. The indeterminate values of the reactions must duly appear in the expression for the moment.

$T_s$ is the corresponding normal force.

$M' = 1$ will produce, in any point, $x$, $y$, a moment 1;

$X' = 1$ " " " " " " " " " $(b - y)$ and a normal force $\left(1 \cdot \frac{d\,x}{d\,s}\right)$;

$Y' = 1$ will produce, in any point, $x, y$, a moment $(a - x)$ and a normal force $\left(-1 \cdot \frac{d\,y}{d\,s}\right)$;

hence, the change of angle of the arch between the point, $O$, and the point, $B$,

$$\alpha = \int_0^a \frac{M_s \cdot 1 \cdot d\,s}{E\,I} = \int_0^a \frac{M_s \cdot d\,s}{E\,I} \quad \ldots\ldots\ldots\ldots (17)$$

the horizontal displacement of the point, $B$, in the direction, $X' = 1$,

$$\Delta_x = \int_0^a \frac{T_s \cdot \frac{d\,x}{d\,s} \cdot d\,s}{E\,A} + \int_0^a \frac{M_s\,(b - y) \cdot d\,s}{E\,I}$$

$$= \int_0^a \frac{T_s \cdot d\,x}{E\,A} + b \int_0^a \frac{M_s \cdot d\,s}{E\,I} - \int_0^a \frac{M_s \cdot y \cdot d\,s}{E\,I} \quad \ldots (18)$$

the vertical displacement of the point, $B$, in the direction, $Y' = 1$,

$$\Delta\,y = \int_0^a \frac{T_s \cdot \left(-\frac{d\,y}{d\,s}\right) \cdot d\,s}{E\,A} + \int_0^a \frac{M_s \cdot (a - x) \cdot d\,s}{E\,I}$$

$$= -\int_0^a \frac{T_s \cdot d\,y}{E\,A} + a \int_0^a \frac{M_s \cdot d\,s}{E\,I} - \int_0^a \frac{M_s \cdot x \cdot d\,s}{E\,I} \quad \ldots (19)$$

which equations will be found useful in many arch problems.

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The author's treatment of Cases VI and VII cannot be said to be new. The same cases and very many others are identically treated by Müller-Breslau,* and it is the writer's impression that the French engineers of the Paris Fair of 1878 designed the many arched structures of the exhibition buildings by this method; also that a description of the method appeared† at about that time. Müller-Breslau has also shown how to simplify greatly the calculations, especially in structures of a symmetrical shape. For example, he transforms the arch structure, shown in Fig. 28, into a kind of statically determined continuous structure in which the left abutment is only able to take vertical reactions of the same amount as those which would be taken by a common girder, and he connects the left end of the arch by an absolutely rigid body with the apex at $O$, at which point, in order to re-establish the equilibrium, he applies the horizontal thrust, $X$, the moment $M_0$, and the indeterminate portion of the vertical reaction, $Y$. He proves that the point, $O$, must be the center of gravity of the so-called elastic weights, $\frac{d\,s}{I}$, of each point of the structure, and if this point is taken as the axis of a system of co-ordinates and $M''$ are the moments of a statically determined system which rests on rollers, and on which no indeterminate reactions are acting, in fact, when $M''$ is the common moment of a common beam, then,

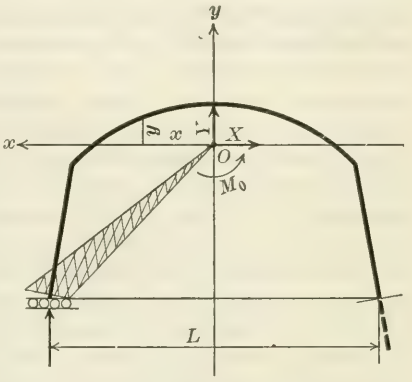


FIG. 28.

$$X = \frac{\int_0^l \frac{M'' \,.\, x \,.\, d\,s}{E\,I}}{\int_0^l \frac{x^2 \,.\, d\,s}{E\,I}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (20)$$

$$Y = \frac{\int_0^l \frac{M'' \,.\, y \,.\, d\,s}{E\,I}}{\int_0^l \frac{y^2 \,.\, d\,s}{E\,I}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (21)$$

$$M_0 = \frac{\int_0^l \frac{M'' \,.\, d\,s}{E\,I}}{\int_0^l \frac{d\,s}{E\,I}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (22)$$

* "Graphic Statics of Indeterminate Structures", 1892.

† In *Le Génie Civil.*

Mr. Mensch.

which are, of course, very much simpler expressions than the often extremely sensitive, and always very involved, Equations (19), (20), and (21), of the author.

French engineers, for nearly 40 years, have been very successful in finding still more important short-cuts in the design of indeterminate structures, and the writer confesses that he would have never designed and built indeterminate structures if these short-cuts, and others which he developed himself, had not reduced the labor of computation often to 10% and sometimes even to 1% of that required according to the methods shown in the ordinary textbooks.

To compute the simplest arch by the ordinary methods in vogue is a considerable task, if the change of the moment of inertia, the change of temperature, and the shortening of the arch are duly taken into consideration. If, in addition, the displacement and rotation of points are to be found, in order to decide about expansion joints in reinforced concrete bridges, it will take the best engineer, if he is not an expert in arch design, probably many weeks of steady and hard work to design a bridge. Generally, the work is done very roughly, temperature and shortening stresses are neglected, and to find displacements of points is not dreamed of. This explains the fact that many bridges crack, although designed with a large factor of safety, also the fact that most American arched bridges, on account of the uncertainty of the designer, are in general very much heavier than those of European design.

It is very important to know that the application of the principles as here developed have many limitations, viz.:

(1) The structure must be in a perfect state of equilibrium.
(2) The deformations must be extremely small.
(3) The stresses must be within the elastic limit, and must follow Hooke's law.
(4) There must be absence of all vibration.
(5) It is assumed that all the work performed by the exterior forces is consumed by the work in deforming the structure, and that the production of heat, and chemical and crystallographic changes are neglected.
(6) Changes of temperature must be computed separately.
(7) Secondary stresses are neglected.
(8) The work in overcoming friction at the abutments or joints is neglected.
(9) Poisson's ratio is neglected.
(10) The influence of the curvature of the structure is neglected.
(11) It is not permitted to apply indiscriminately the statics of a rigid body. In a framed structure, for example, where a force is acting at a lower joint, it is not permitted to assume that its point of application might be indifferently at any point

of its line of action. If the line is extended to the upper chord, it would probably produce bending there, and the work done would be quite different. Mr. Mensch.

(12) The influence of shearing forces (of great importance in dams, for example), is neglected.

These limitations apply to both determinate and indeterminate systems, and have as yet received comparatively little study by investigators. Some of these points, however, are of great importance, and the figures may be out 50% and more; and in many structures one cannot predict the factor of safety.

Of the utmost importance is the behavior of materials when it differs from Hooke's law, as when a structure is stressed beyond the elastic limit, or, as in concrete construction, where the time-flow or the plasticity of the concrete might reduce the modulus of elasticity for the dead-load stresses to perhaps one-tenth of the value of that under a short-time load. As a rule, the factor of safety is increased, due to the flow of the material, and the stresses in the dangerous section remain nearly constant with gradually increased loads, and the comparatively stronger parts take up more stresses than have been computed until a new state of equilibrium is reached.

F. E. Turneaure,* M. Am. Soc. C. E. (by letter).†—This paper presents a very interesting development of a principle in the theory of structures which, so far as the writer knows, has not been made use of heretofore. The principle itself is not exactly new to the writer, and its application to the determination of stresses in redundant members, or the determination of redundant reactions, is quite fully set forth in his revision of Johnson's "Framed Structures", Part II, 1910. Chapter VI of this work reviews, in the first few pages, the general principles and formulas used in the determination of redundant stresses, and then applies these principles to quite a variety of selected problems. In the general formula, Equation (5), page 335, of this work, an equation is given expressing the relation between redundant stresses, $S_1$, $S_2$, $S_3$, etc., and the stresses and bending moments due to the external loads. Following this equation, the statement is made: Mr. Turneaure.

"Instead of assuming as the unknowns the various direct stresses, $S_1$, $S_2$, etc., it is sometimes more convenient to take certain of the bending moments as the unknowns, or certain direct stresses together with certain moments. In this case the values of $u_1$ and $m_1$, corresponding to an unknown bending moment, $M_1$, are respectively the stresses and moments in the various members due to a bending moment of unity in the redundant member. The resulting equations are then the same as Equation (5) excepting that certain unknown moments, $M_1$, $M_2$, etc., are used instead of the stresses, $S_1$, $S_2$, etc."

* Madison, Wis.

† Received by the Secretary, April 24th, 1919.

Mr. Turneaure.

The general method thus fully set forth, applied to the problem given by Professor Swain as Case VI, would, on substitution of the proper notation in Equation (5) referred to, produce precisely his Equations (16), (17), and (18). In presenting this method of attack, it was also recognized by the writer, as indicated in the subsequent article, especially on page 336, that the quantities, $\Sigma \frac{s\,l}{E\,A} \cdot u_1$ and $\Sigma \int \frac{M\,d\,x}{E\,I} \cdot m_1$ (identical with those of Professor Swain's Equation (4)), represent the change in angle of the member under the actual conditions of loading, the quantities, $u_1$ and $m_1$, being the direct stress and bending moment, respectively, in any member due to a unit moment applied at the point the angular change of which is desired.

While thus setting forth the practicability of applying unit bending moments as well as unit forces in problems of this kind, the writer, as a matter of fact, did not follow this method in numerical problems, primarily for the reason that the solution adopted in any particular case was that which appeared to be the most convenient and expeditious. For example, in the solution of various problems of portals or quadrangular frames fixed at the base, the method for arches was generally used. This method assumed as the redundant quantities the shear, thrust, and bending moment at the crown. Three equations for the determination of these three unknown quantities were derived by equating the horizontal and vertical components of deflection and the angular change at this point for the two sides of the arch. The expression for the angular change of the arch axis at the crown is really identical with the form of expression derived by Professor Swain, although it is apparent that a mere familiarity with this expression would not be apt to lead to the generalization in Professor Swain's paper. His explanation of how this principle may be applied in determining changes of inclinations of any member of a structure is very interesting, and will doubtless prove of value in many practical problems.

Referring to the foot-note on page 75, in which Professor Swain explains the character of the units in Equation (1), it seems to the writer to be somewhat more logical to consider that the quantity, $t$, is merely a ratio, or an abstract number, which, multiplied by $\frac{s\,l}{E\,A}$, results in a length. The quantity, $\frac{s\,l}{E\,A}$, is the actual change in length or movement of the member distorted, and the quantity, $t$, is simply a factor by which this change in length is multiplied in order to determine the contribution of this particular member to the deflection desired. It is a mere ratio, and when determined by the ordinary

process of calculating the stress in a member due to a unit load, it represents, not the stress itself, but the ratio of stress to load; but, the load happening to be unity, the numerical value of the ratio is the same as that of the stress. This factor or ratio, $t$, can be determined in other ways, as, for example, by the principle of virtual velocities, or by the principle of work, or by applying differential calculus to the linear dimensions of the frame-work. In any case, it may be looked on as simply a ratio, and hence the product of this ratio multiplied by the length is a length. Mr. Turneaure.

AMERICAN SOCIETY OF CIVIL ENGINEERS

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# PAPERS AND DISCUSSIONS

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## THE EAST CANYON CREEK DAM.

### Discussion.*

By Edward Godfrey, M. Am. Soc. C. E.

Mr. Godfrey.

Edward Godfrey,† M. Am. Soc. C. E. (by letter).‡—Mr. Parker has shown wisdom in selecting a low unit stress for the concrete of this arch dam. Reduced to square inches, this unit stress is 174 lb. It is true that there are venturesome souls who would use concrete stresses as high as 850 lb. per sq. in., as Mr. Parker states, and these men call themselves engineers because they spend one dollar where others would "squander" several.

From the achievements of structural steel designers, in which factors of safety are sometimes about two or less (the elastic limit being considered the point of ultimate usefulness), an argument might be constructed for higher units in concrete, which would look plausible enough on its face. Steel and concrete, however, are quite different in their behavior.

If a dam begins to show signs of weakness, it does not help matters to post notices to reduce the loads, as in the case of failing or inadequate buildings. There are many buildings and other structures which never receive the loads they are supposed to carry. Some of them would collapse if they did.

There are many arguments for conservatism in the selection of unit stresses in the design of a dam, chief of which, of course, is the dire consequence of its failure. Next comes the argument as to the certainty of the realization of the load (already hinted at). Other reasons for low unit stresses will be mentioned later.

Unit stresses in dams received little notice in the days when gravity dams were built almost exclusively. Much was written some

* This discussion (of the paper by A. F. Parker, M. Am. Soc. C. E., published in March, 1919, *Proceedings*, and presented at the meeting of May 7th, 1919), is printed in *Proceedings* in order that the views expressed may be brought before all members for further discussion.

† Pittsburgh, Pa.

‡ Received by the Secretary, April 28th, 1919.

Mr. Godfrey.

years ago concerning shear in a gravity section, but this was in the days before under-pressure began to be recognized as a factor to be considered in the stability of dams and a cause of most failures. If a gravity section is properly designed for under-pressure, in construction joints and beneath the dam, vertical shear in wide-spreading toes need give no concern, for those toes will have no existence.

When hollow dams and multiple- or single-arch dams began to be built, more care was necessary in the matter of unit stresses. Even then, and before and since that time, the one great essential in design was often neglected, namely, the applied loads. It would seem to be a simple matter to know and provide for the pressure of water, for that pressure is so sure, and obeys laws that are quite well known. In spite of this, there is not a book in the English language (excepting very recent ones) that even mentions the great force of water in horizontal joints and at the base of a dam. Consequently, an engineer is at a disadvantage in designing a dam, especially when he sees elaborate calculations, to find the true theoretic cross-section, that ignore entirely forces of tremendous moment which render these calculations utterly void. Mr. Parker's paper does not state that he considered under-pressure. It is true that this does not affect the stability of an arch dam so vitally as it does that of a gravity dam or a hollow dam; but, if the section of an arch dam should be so light that its weight would approach that of a prism of water conceived to be constructed on its base, a danger point is reached where the dam is likely to be raised from its base and thus allow water to work beneath it, a wash-out resulting. If the dam had other than a good solid end abutment, settlement at the arch ends might aid to raise the base at the crown of the arch ring. This is one of the reasons for using low units in the arch ring. The low unit will mean greater thickness of the latter and greater weight and stability for the dam.

Consideration of under-pressure, also, ought to lead to a design in which the batter is on the up-stream face, for such a batter adds to the pressure on the foundation by the amount of the weight of the water lying vertically over the battered face. Furthermore, a batter on the up-stream face tends to throw the end thrust of the arch downward, instead of in a horizontal direction, thus adding to the stability of the arch. Mr. Parker has made the greater part of the batter on the down-stream face. In the tangent portion the batter should be made on both faces, in order to obtain the spreading effect at the abutments, but, the writer is of the opinion that the stability would be greater if all the batter were made on the up-stream face in the arch portion.

Another reason for reducing the unit stress of an arch of this length is expressed by the term "column action". The arch resembles a column of very considerable unsupported length, just as a hollow tube under external pressure resembles such a column. A tube under

Mr. Godfrey.

external pressure acts about as a column of a length (hinged-ended) equal to half the circumference. Therefore, the ring of an arch dam should be treated as a column, and its length is equal to that of the arch from abutment to abutment. Of course, support is offered by the base of the dam. This is similar to the support afforded to a wide flange of a girder by the stiffness at the root of the flange. The arch dam is not, as some have claimed, equivalent to a short column.

Just what reduction should be made in unit stresses for wide, thin flanges is not very well understood or codified by structural engineers. A rule used in the case of girder flanges is to limit the thickness to one-twelfth of the width of the outstanding leg. Girder flanges are generally otherwise stiffened at intervals, and their maximum stress occurs only throughout a small portion of their length. The dam should be designed on a much safer basis than this, because: first, concrete has not the toughness of steel; second, the full stress exists from end to end of the arch; third, mere support on the earth is not equivalent to the strength at the root of a girder flange angle; and fourth, there are no braces at intervals in the arch dam. Mr. Parker's dam has a ratio of height to base thickness of six or seven, due to his commendable selection of a low unit stress. If he had elected to adopt the high unit stresses favored by some designers, the writer is of the opinion that the result would have been hazardous.

Another reason for low unit stresses is the uncertainty regarding the distribution of the stress throughout the section. Shrinkage of the concrete, expansion due to moisture, or changes due to varying temperature, are sure to result in unequal distribution of compressive stress on the section of the dam. The great length of the dam would make these variations of greater magnitude in this than in a smaller structure.

Hollow dams have proved most forcibly, by four notable failures, that the type having a bottom slab resting on the soil is an error. Three of these dams failed in winter, when, presumably, the weep-holes were frozen up; in the other case the weep-holes had been plugged up in order to save water. Upward pressure caused the failure of these hollow dams. It does not act to overturn them, but merely lifts them from the soil and thus permits the passage of water beneath the dam, which washes away the foundation, and failure results. Part of Mr. Parker's dam is hollow, but, fortunately, there is no bottom slab joining with the inclined slab, and the solid portion has considerable weight. It is probable that the rock formation is such as to preclude the possibility of water pressure under the solid portion being communicated across the gap between the inclined slab and the solid bottom part of the dam.

If this separation of the inclined slab and the solid bottom is intentional and general (and not merely accidental in the section,

Mr. Godfrey.

Fig. 3), it is fortunate, as it differentiates this dam from the hollow type which has furnished the four failures referred to.*

There is also considerable mass in the hollow portion of Mr. Parker's dam, and that helps to hold it down against upward pressure. Mr. Parker has used dowels to anchor the concrete to the masonry. Such dowels might help, but the writer would not be inclined to place much confidence in them, either for this purpose or for preventing the slipping of the arch abutments, where the line of thrust makes a rather sharp angle with the rock face. For the latter he would prefer to blast out the rock face in steps, the several steps being nearly normal to the line of thrust, or holes might be blasted for keys in order to prevent slipping. If he were building on a sloping rock, he would not wish to trust to dowels to prevent the structure from slipping down the slope, but would cut steps in the rock.

In the north tangent the thrust is carried by rectangular columns or shafts between the piers. These members are reinforced with steel rods. The compression on these members is about twice as great as that on the arch ring. Twisted steel rods, 1 in. square, are placed longitudinally in these members, for the purpose of taking compression, and these rods are surrounded by what Mr. Parker calls hoops. It is unfortunate that the term "hoop" should be applied to a piece of steel bent in a rectangular shape. It is more unfortunate that it should be imagined that such pieces of steel can act in a manner similar to hoops in a hooped column. A mere term can be used in such a way as to create a false sense of security (witness the term "column" applied to two little channels tied together with small battens at intervals). A hooped column is a properly reinforced concrete member in compression, but, a member with rods disposed in a rectangle with square ties at intervals of about 12 in. is not a hooped column, and is not properly reinforced. The rectangular tie can only act to hold the four corner rods against lateral displacement, and the intervals between such ties should be closer than 12 in. in a properly hooped column.

Again, twisted rods are not of the proper shape for compression members; they should be as straight as possible.

Of course, the unit stress in these columns is not great, but, in the writer's judgment, it would be better to make the section of these members as large as that of the arch, and to use steel merely to tie the concrete together, and not to take compression.

The rodded column is the most discredited piece of construction that can be named. In almost all of more than a score of bad reinforced concrete wrecks rodded columns have proved their unfitness. Many large and chunky columns, carrying trifling loads, have broken into pieces, instead of standing and sustaining their share of the load.

* Pittsfield Dam, *Engineering News*, April 1st, 1909; Dansville Dam, *Engineering Record*, January 1st, 1910; Stony River Dam, *Engineering News*, January 22d, 1914; and Plattsburg Dam, *Engineering News*, June 8th, 1916.

AMERICAN SOCIETY OF CIVIL ENGINEERS

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# PAPERS AND DISCUSSIONS

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## PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES.

### Discussion.*

By Otto V. Kruse, Assoc. M. Am. Soc. C. E.

Mr. Kruse.

Otto V. Kruse,† Asso. M. Am. Soc. C. E. (by letter).‡—The writer has studied the phenomena of water-hammer, and offers a short analysis of Miss O. Simin's translation of Prof. Joukovsky's notable work, and an elaboration of certain parts of Mr. Gibson's paper.

Any pipe under pressure and containing water in motion may be assumed as a unit of energy under a condition of equilibrium. If we wish to stop the column of water, it means the application of a certain amount of force during a certain time to bring about the conversion of energy and restore the equilibrium. In analyzing the phenomena which take place, the writer believes that the most important point to study is the rate of destruction of velocity as affected by the net head, because this determines to a large extent the rate of pressure rise and hence the maximum pressure rise. Apparently, Allievi used this as a basis for the development of his formula, and this, of course, applies to Johnson's formula, which is the same as Allievi's. Any formulas, such as Warren's and Vensano's, which do not take this into account must be incorrect, except for one set of conditions. The curves given by Mr. Gibson show how far from the truth they may be.

* This discussion (of the paper by Norman R. Gibson, M. Am. Soc. C. E., published in April, 1919, *Proceedings*, but not presented at any meeting), is printed in *Proceedings* in order that the views expressed may be brought before all members for further discussion.

† Philadelphia, Pa.

‡ Received by the Secretary, March 5th, 1919.

Mr. Kruse.

In accordance with the ordinary methods of integration, it may be considered that the gate movement throughout the duration of the stroke is made up of an infinite number of small instantaneous movements. In the case of the formulas of Allievi and Johnson, which involve the dynamic forces, each little movement of the gate produces a pressure:

$$h = \frac{L\,dv}{g\,dt}$$

The conditions existing, then, at the end of any small movement are:

1. The original velocity has been decreased by the amount of the velocity destroyed during this first movement;
2. A dynamic pressure has been created due to the destruction of velocity.

A new velocity now exists, which is dependent, not on the original net head, but on a new head made up of the original net head and the dynamic head. As brought out by Mr. Johnson, these curves of dynamic pressure-rise and decrease in velocity may be calculated by a simple method of arithmetic integration, using only the relation, $h = \frac{L\,dv}{g\,dt}$. The Allievi or Johnson formula will give a figure for maximum pressure rise, and Mr. Johnson has also developed a formula for the shape of the pressure curve, these formulas giving the same results as can be obtained approximately by arithmetic integration.

The question to be considered now is: To what extent, and how, do the compressibility of water and extension of the pipe walls affect the pressure and velocity curves? We know that, as the time of closing grows shorter, the Allievi formula approaches infinity. On the other hand, Joukovsky proved that the maximum pressure which obtained for instantaneous closing depended on the velocity destroyed and the speed of propagation of the pressure wave, and could not exceed "maximum water-hammer." It is not difficult to see that, for a long closing time, the compressibility of the water and extension of the pipe walls have very little effect on the maximum pressure, but, as the time of closing grows shorter, the properties of the materials have a greater and greater effect. The writer believes that Mr. Gibson's formulas have successfully supplied this missing gap between Allievi's and Joukovsky's theories, and serve to give correct results for all conditions.

Professor Joukovsky made a great many experiments to determine the magnitude of maximum water-hammer and the speed of propagation of the pressure wave, all based on instantaneous closing of the gates. The details of the experiments will not be given here, but the following is a synopsis of the theory, taken verbatim from Miss Simin's translation:

"In Fig. [10] let $A$ $B$ be a pipe, in which water flows with velocity, $v$, from the origin $A$, past the gate, $B$. If, now, the flow is suddenly stopped by a rapid shutting of the gate, $B$, the kinetic energy of the water column, $A$ $B$, will cause an increase of pressure in the pipe. Mr. Kruse.

"Let us consider the column of water, $A$ $B$, as divided into $n$ very small equal sections, 1, 2, 3,.... $(n - 1)$ and $n$.

"The phenomena of water-hammer take place in a series of cycles, each consisting of four processes, as follows:

"(1) Section 1, meeting, in the gate, an obstacle to its movement, will be compressed and will stretch the pipe wall surrounding it. All the kinetic energy of this section of water will be used up ($a$) in its own compression, resulting in the increase of pressure by an increment, $P$, and ($b$) in the corresponding stretching of the walls in section 1 of the pipe. As a result of this action, section 1 of the water column has left vacant behind itself a small space, to be occupied by a part of the next arriving section 2. Consequently it is only after section 1 has been stopped and compressed, and after the small space thus left has been filled, that section 2 can be arrested and compressed.

"Now the kinetic energy of section 2 must be expended in some way. Will it increase the pressure upon the gate, which has already been caused by the arrest of section 1? No, and for the following reason:

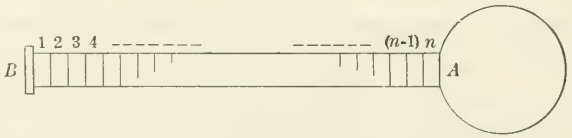


FIG. 10.

"The pressure upon the gate depends entirely upon the pressure, $P$, sustained by section 1, which is now in static condition.

"The pressure upon the gate could therefore be increased only if section 1 could be farther compressed, and this could take place only if the pressure upon the surface between it and section 2 (which we may imagine to be a thin piston) could be greater from the side of section 2 than it is from the side of section 1; and this is impossible, because section 2 has only the same kinetic energy as section 1, and this energy will (as in the case of section 1) be used up entirely in compressing the water of the section (section 2) only to the same additional pressure, $P$, and in stretching that part of the walls surrounding section 2.

"The same is true of each following section, 3, 4,.... $(n - 1)$ and $n$; each of these sections, as it is arrested, being compressed to the pressure, $P$.

"During process (1) a small quantity of water flows from the reservoir into the pipe, to occupy the space formed by the compression of the water and the extension of the pipe walls.

"Finally, when all the sections have been arrested, the entire column will be under the pressure, $P$. The entire energy of the water column is now stored (as potential energy) in elastic deformation, viz., in the compression of the water column and in the extension of the pipe walls.

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"But this condition cannot be maintained; for

"(2) As soon as the additional pressure, $P$, has been produced in the last section, $n$, the water in that section will again expand, and the walls of that section of the pipe will again contract, restoring the original conditions in that section, and pushing the water of that section back into the reservoir from which the pipe issues, and restoring the original normal pressure in section $n$.

"This operation will now be repeated by each section $(n - 1),\ldots.4$, 3, etc., in turn, until all the potential energy, stored in the water column when it was under the pressure, $P$ (neglecting the portion lost in friction), has been reconverted into kinetic energy.

"During process (2) the water which entered the pipe during process (1) is forced back into the reservoir.

"The condition of the water column is now what it was just before the gate was closed, except that its velocity, $v$, has now the opposite direction, *i. e.*, toward the origin.

"(3) The kinetic energy of the water column, moving toward the origin or away from the gate, is now reconverted into potential energy, which manifests itself in an extension of volume of the water to a subnormal pressure beginning with section 1, and concluding only when the entire water column has been reduced to the subnormal pressure.

"During process (3) water continues flowing from the pipe into the reservoir.

"(4) When the subnormal pressure has been established throughout the length of the pipe, and all the water has come to rest, the water from the reservoir will again direct itself into the pipe, restoring the normal pressure, first in section $n$, next to the reservoir, and then, in rapid succession, in the other sections $(n - 1),\ldots.4$, 3, etc., until, when the normal pressure reaches the gate, we have once more the conditions which existed just before the gate was closed, viz., the normal pressure is restored and the water is moving toward the gate with the original velocity, $v$.

"We have now followed these pulsations of pressure (with the accompanying transformations of energy and flow of water into and back from the pipe) through a complete cycle of four movements, each extending through the length of the pipe. For convenience, we may consider two successive movements of this kind as a 'round trip' through the pipe.

"The gate remaining closed, the whole process is now repeated in a second cycle, which, in turn, is followed by a third, and so on, the amplitude of the pressure vibrations gradually diminishing (because of friction) until the pipe and the water come to a state of rest.

"But although the intensity of the pressure becomes gradually less, the time required for each cycle remains constant for all repetitions.

"This propagation of pressure, consisting of its transmission through all points of the length of the pipe, each point successively repeating the same periodical movements, is, in its nature, simply a case of wave motion, like that of a sound wave.

"The velocity of wave propagation is independent of the intensity of the pressure, and depends only upon the properties of the medium through which the propagation takes place—in the case of water-hammer, upon the elasticity of the water and of the pipe."

Mr. Kruse.

Mr. Gibson has applied this theory to slow-closing gates by considering that each infinitesimal movement of the gate is instantaneous and produces a small rise of pressure which travels through the penstock in the same manner that a wave produced by total instantaneous closing would travel. These small gate movements occur in succession and produce in turn their pressure waves which travel back and forth through the penstock. An algebraic sum of these waves gives the rise of pressure existing at any time during the closing stroke.

The writer is of the opinion that the pressure existing throughout the length of the pipe for a slow-closing gate varies almost directly from a maximum at the gate to zero at the point of relief, except where the time of closing is less than $\frac{2\,L}{a}$.

In Fig. 11, the pressure existing at four points on the penstock has been plotted. The magnitude of the individual pressure waves is not to scale, but their values are shown for the particular example taken. The pressure existing at a point $\frac{L}{2}$ from the gate is approximately one-half the pressure existing at the gate. The pressure existing at a point $\frac{3\,L}{4}$ from the gate is approximately one-quarter of the pressure existing at the gate.

The diagram showing the pressure existing at the point of relief consists of a series of instantaneous rises above normal. On account of the assumption of twelve instantaneous movements of the gate, the pressure at the point of relief must of necessity show twelve instantaneous rises of pressure, as each wave travels undiminished to the point of relief. If twenty-four instantaneous movements were chosen, there would appear twenty-four instantaneous rises of pressure in the same time, but of only about half the magnitude. Hence, in the limit of an infinite number of instantaneous movements of the gate, or uniform slow-closing, the pressure at the point of relief becomes zero. This must be true, because the duration of time of any rise of pressure at the point of relief is zero. Wherever rises of pressure have actually been recorded at the point of relief on a penstock, they are probably due to an instantaneous movement of the gate during the stroke, or to some other cause, such as a sudden elastic deformation of the waterway, which would have the same effect.

In the translation of Professor Joukovsky's work there are shown tables of pressure rises at different points on the pipes for different velocities destroyed. In every case the pressure waves travel practically undiminished almost to the point of relief. The readings taken at the station nearest the point of relief, however, show a reduction in pressure of from 60 to 80 per cent. This is very significant to the writer,

Mr. Kruse.

as an indication that the pressure traveled undiminished to a certain point and then gradually was reduced to zero at the point of relief. Although Professor Joukovsky experimented with very rapidly closing gates, as nearly instantaneous as possible, obviously a certain fraction of a second must elapse while the gate is closing. When the time of closing is less than one interval, $\frac{2L}{a}$, the resultant pressure will travel undiminished to a point which is $\frac{Ta}{2}$, in feet, from the point of relief (where $T$ is equal to the closing time, in seconds). From this point it will gradually be reduced to zero at the point of relief. Granting that some short period of time must elapse during the closing of the gates in Professor Joukovsky's experiments, his actual pressure readings seem to verify the writer's claim.

In the example taken, the duration of closure is assumed to be three intervals. The diagrams and curves have been plotted beyond the three intervals to show the fluctuations of pressure which take place after the gates are closed. Experiments should show that the subsequent fluctuations after the gates are closed are quickly reduced in intensity by internal friction, but this friction should have no effect on the speed of propagation of the pressure waves. Internal friction has of necessity been omitted in these computations, as it is an unknown quantity.

Any other example than that shown by Fig. 11 may be chosen, and the pressure waves may be computed by Mr. Gibson's formulas. A series of diagrams may then be plotted, similar to those shown by the writer, and the pressures may be computed for any point on the penstock.

In making the computations for the magnitude of the pressure waves, it is necessary to determine first the number of intervals of time $\left(\text{equal to } \frac{2L}{a}\right)$ contained in the total closing time. The gate movement may then be divided into a number of instantaneous movements equal to the number of intervals. Computations carried out on this basis will give correct points on the pressure-rise curve at the end of each interval. In the event of the closing time being only a few intervals, it is desirable to subdivide the gate movement further in order to develop the curve during the intervals. It is an interesting fact, however, that such further subdivision of gate movement serves only to develop the shape of the curve during the intervals, and has no effect on the values at the end of each interval. In making studies of this character, it is often easier instead of using Mr. Gibson's formulas, to utilize the system of arithmetic integration, which will give correct results, although involving trial-and-error methods.

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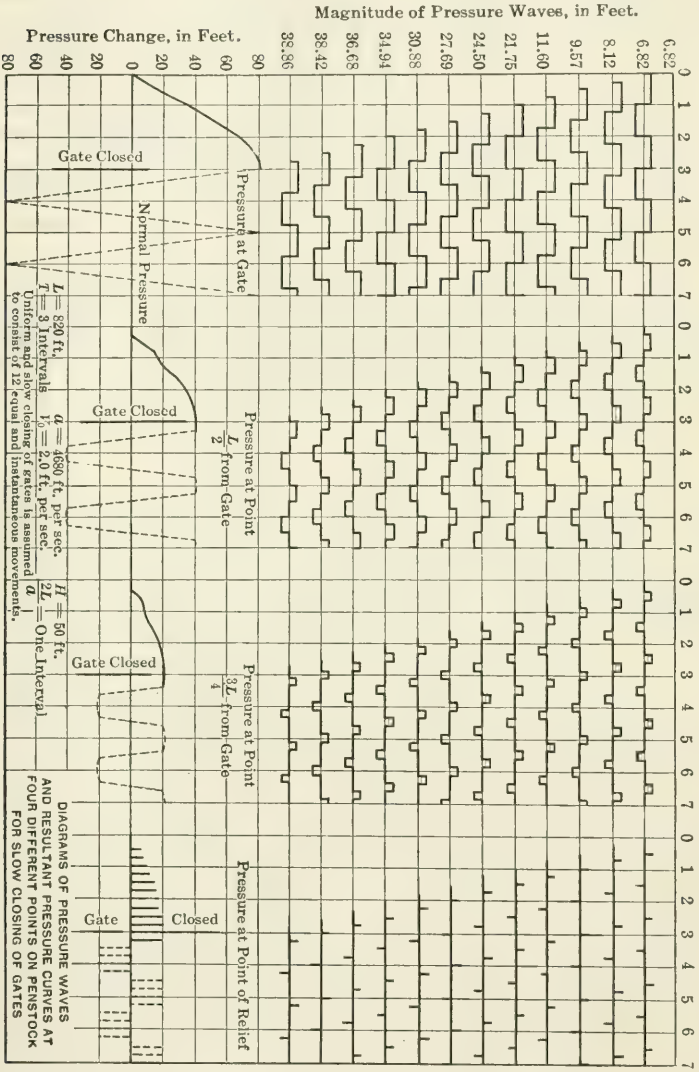
Magnitude of Pressure Waves, in Feet.
0 6.82 8.12 9.57 11.60 21.75 24.50 27.69 30.88 34.94 36.68 38.42 38.86
Time, in Intervals.
0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
Pressure Change, in Feet.
80 60 40 20 0 20 40 60 80
Gate Closed
Pressure at Gate
Normal Pressure
Gate Closed
Pressure at Point L/2 from Gate
Gate Closed
Pressure at Point 3L/4 from Gate
Pressure at Point of Relief
Gate Closed
DIAGRAMS OF PRESSURE WAVES AND RESULTANT PRESSURE CURVES AT FOUR DIFFERENT POINTS ON PENSTOCK FOR SLOW CLOSING OF GATES
L = 820 ft.
T = 3 Intervals
Uniform and slow closing of gates is assumed to consist of 12 equal and instantaneous movements.
a = 4680 ft. per sec.
V0 = 2.0 ft. per sec.
H = 50 ft.
2L/a = One Interval

Fig. 11.

Mr. Kruse.

In order to compute the pressure-rise curve at points on the penstock other than at the gate, the gate movement must be divided into a number of divisions sufficient to cause the pressure waves to overlap. Thus, at least two divisions per interval must be used to compute the curve at a point half way up the penstock, at least four divisions per interval for a point three-quarters of the way up the penstock, and at least eight divisions per interval for a point seven-eighths of the way up the penstock. Referring to Fig. 11, where four divisions per interval were chosen, it is obvious that the pressure beyond the point, $\frac{3\,L}{4}$ from the gate, cannot be computed without a greater subdivision of the gate movement.

In this discussion the writer has endeavored, principally, to point out the trend of argument and application of existing data used in proving the theoretic correctness of Mr. Gibson's method of handling water-hammer problems. The method seems to be fundamentally sound, and deserves the careful thought of engineers.

AMERICAN SOCIETY OF CIVIL ENGINEERS

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# PAPERS AND DISCUSSIONS

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## AMERICAN HIGHWAYS

An Informal Discussion at a Meeting of the Society, April 16th, 1919.

By Messrs. W. G. B. Thompson, H. Eltinge Breed, Eugene W. Stern, and Calvin Tomkins.

Mr. Thompson.

W. G. B. Thompson,* Assoc. M. Am. Soc. C. E.—The population of what is generally known as the metropolitan district of New York is, at present, approximately 7 000 000 people, and is rapidly increasing in volume and density. This district may be said to embrace Brooklyn, Queens, Richmond, Manhattan, the Bronx, and the territory of New Jersey lying between the Hudson and Passaic Rivers.

Approximately, 30 000 miles of railroads have their termini on the New Jersey side, and seventy or more steamship lines operate from the joint port to all parts of the globe. Traffic and freight transfer conditions are daily becoming more difficult to handle, economically and expeditiously, and, unless an immediate and serious effort is made to devise a general plan or scheme which will co-ordinate all the factors in the problem in a manner to afford early relief, with ample provision for indefinite future expansion, not only the supremacy of the Port of New York will be endangered, but the very existence of its people (especially on Manhattan Island), may conceivably be threatened. This was exemplified during the winter of 1917-18 when severe weather and ice prevented coal movement by water to the city, and during the recent strikes of harbor boatmen, when coal and food supplies were threatened, and thousands of workers were unable to proceed to their offices and shops, due to the ferry systems being tied up.

It will be especially interesting to note the effect on the daily supply and life of the city in connection with the general harbor strike called

* Trenton, N. J.

Mr. Thompson.

for April 15th, 1919, when 16 000 men may quit work because of differences with employers. According to the plans of the strike leaders, not a single exception is to be made in favor of any class of harbor activity. The leaders claim that unionists will quit Army and Navy craft, except where manned by enlisted service men. They will also quit all railroad ferries and, it is reported, will refuse aid in berthing hospital ships from abroad. They propose, also, to attempt to tie up coastwise and transatlantic shipping, and to try to enlist the Sandy Hook pilots. The strike is also aimed at the Railroad Administration. If effective with regard to that organization, a serious menace to the coal supply of New York is in sight.

The speaker will not discuss the merits of the proposed strike or the conditions which make possible such a deplorable state of affairs, where a comparatively small body of men may actually endanger the physical existence and paralyze the economic life of a city of 3 000 000 people in order to satisfy their own particular desires. Such conditions give added emphasis to the idea that the development of New Jersey's highways to their highest efficiency and the construction of vehicular tunnels under the Hudson River are intimately connected with the future welfare of New York City.

The construction of one or more vehicular tunnels under the North River, if such tunnels are wisely designed to provide for future increase in vehicular traffic between New Jersey and New York, will go far toward removing the possibility of a future food shortage in New York City.

It is granted that freight and foodstuffs may be brought from Long Island, from New England, and from the West, *via* Buffalo and the Poughkeepsie Bridge, which in a measure would alleviate conditions arising from a future tie-up of harbor transportation; it is a fact, however, that by far the greater proportion of the food and daily necessities of New York City come through the freight yards on the New Jersey shore, and that even a slight interruption in the continuous flow is serious, when it is considered, as has been asserted, that Manhattan Island has but 7 days' supply. It is also admitted that coal and other freight may be brought through the Hudson River Tunnel to the Pennsylvania Railroad Station at 34th Street and Seventh Avenue, but the passenger terminal lacks adequate facilities for freight handling, and cannot be considered an important factor as a freight-receiving and distributing point without serious interruption to the passenger traffic; therefore, development of means of vehicular transportation between New Jersey and Manhattan Island at an early date is imperative. Relative to this matter, it is interesting and gratifying to note that Governor Edge of New Jersey and Governor Smith of New York have signed bills which will enable preliminary steps toward actual construction to be undertaken.

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It is well known that the present ferry system is incapable of handling the vehicular traffic expeditiously. Long lines of trucks now stand many hours awaiting their turn to cross the river from both sides, and the delay, being costly to all concerned, naturally affects most heavily the ultimate consumer. Statistics, compiled in connection with an investigation made by the Public Service Corporation of New Jersey, show that 6 130 945 vehicles of all classes use the North River Ferries between 130th Street and Cortlandt Street annually. These figures are based on an average week day record, multiplied by 300 for week days, and a Sunday record multiplied by 65 for Sundays and holidays.

The normal increase in vehicular traffic is estimated to be between 3 and 5% per year. Considering this fact, and, further, that the ferries are now unable to handle the traffic, that the possibilities of further expansion of the ferry service are exceedingly limited, and that, even if the ferry terminals could be extended, the North River is now overcrowded with craft of every description, it is evident to men who have studied the matter seriously that at least one tunnel should be constructed as soon as possible.

It is estimated that 2 000 000 vehicles per year will use the tunnel. It is evident from these figures that the present congestion and long waits at the ferry entrances will be reduced very materially, if not obviated altogether. How long the proposed tunnel at Canal Street will serve properly the needs of cross-river traffic is a matter for conjecture. Mr. Edward R. Viets, of the Service Recorder Company of Cleveland, states that the number of motor trucks increased from 60 000 in 1912 to 600 000 in 1918. As the increase in the use of motor trucks follows rapidly the construction of good roads, and the greatest road construction period the country has ever known is just opening, it is reasonable to assume that the annual increase in the number of trucks will be as great during the next 6 as during the past 6 years. As a consequence of this, and the natural increase in volume of business within 30 miles of New York City, one may reasonably look for a recurrence of the present congestion by 1928, if not earlier; it would seem, therefore, that even before Tunnel No. 1 has been completed, consideration should be given to investigating a site for Tunnel No. 2. There is ample precedent for such action when one considers the East River. Considerable courage was required to start the construction of the Brooklyn Bridge. Not very many years after its completion came Bridge No. 2, then Bridge No. 3, and then Bridge No. 4. The capacity of these bridges is now sometimes severely taxed, notwithstanding that there are many ferries plying between Brooklyn and Manhattan Island. The population of Brooklyn is approximately 2 500 000. The population of New Jersey in the metropolitan district is approximately 1 500 000. Consider these facts, and, further, that the construction of Hudson Vehicular Tunnel No. 1 will facilitate and

Mr. Thompson.

stimulate business to such an extent as to increase rapidly the population of metropolitan New Jersey, that there will be created the same conditions which made necessary the construction of additional bridges over the East River. The completion of the present New Jersey Highway System, and its further extension as finances and conditions warrant, will but add to the burden converging on the Hudson River between 42d and Cortlandt Streets.

It does not require a long stretch of the imagination to picture New Jersey's highway system as playing an important part in keeping New York City supplied with many necessities, especially when freight terminal congestion (which is inevitable at such an ill-equipped port) makes the handling and lightering of New York City and foreign freight difficult and tedious, more particularly in winter. Just a word as to the scope of this highway system as now laid out: The State Legislature of 1917 created a State Highway Commission of eight members, two of whom are members of this Society, and six of whom are well-known business men. There was also established a State Highway System, comprising 655 miles of the main traveled routes of the State, which serve well its industrial and agricultural regions. They are all tied together, and, in effect, radiate from or terminate on the New Jersey shore of the Hudson. Owing to its geographical position, New Jersey is the throat through which must pass all traffic from New York and points east to Philadelphia and points west and south. An unusually heavy burden of foreign traffic is thus imposed on the highways between the Hudson and the Delaware at Trenton. As an indication of its volume and weight, a traffic census taken early in 1918 showed a total daily weight of approximately 7 900 tons, including vehicles, freight, and passengers on a part of the Trenton-Newark highway between New Brunswick and Elizabeth. This is for one route only, and is an indication of the potential value of the highway system as a supplement to the railway system, especially considering the rapid increase in the number of motor trucks, which will follow the construction of pavements adequate to sustain them. Within one year there will be hard, smooth pavement on good alignment and easy grades, from the Hudson to the center of New Jersey's richest agricultural district. This will make possible direct trucking from farm to market or consumer. Even now, fruits and vegetables are trucked from points south of Trenton to the New York market daily. The completion of the tunnel will enable this produce to proceed uninterruptedly to New York, instead of waiting many hours for ferry passage.

In order to provide a highway for traffic to and from Hudson River points without passing through the congested Newark streets, the Counties of Essex and Hudson, with aid from the State, are now making investigations looking toward the construction of a highway bridge over Newark Bay between Bayonne and Elizabeth, by which

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vehicular traffic may reach the Hudson County Boulevard, and thence go directly to the tunnel and ferries, shortening the motoring time between Elizabeth and Jersey City by at least 30 min. The State Highway Commission, in building a new road over the Palisades to Fort Lee Ferry in Bergen County, is doing much to relieve the congestion at the lower river ferries. The major portion of truck traffic from the Passaic and Hackensack Valley industries must now use the down-town ferries. The proposed new approach will provide a direct route from Paterson to 130th Street, New York City. The grades will not exceed 6.5%, and will be much lighter than on any present approach over the Palisades to the ferries. This will also enable heavily loaded trucks, bound to or from upper New York State, Connecticut, and Massachusetts, to avoid down-town New York City, when *en route* to or from New Jersey and Pennsylvania points.

The completion of State Highway Route No. 9 will open a direct smoothly paved road from New York to the Delaware River at Easton, Pa., whence there is a fine paved highway to South Bethlehem. As a peace time highway, this will have great commercial as well as scenic value. As a war time highway, its value would be inestimable, as it would connect the great Schwab plants directly with the Port of New York.

All the great industries of the Delaware River as far south as Wilmington, Del., will be connected directly with New York City by hard, smooth highways, by the autumn of 1920. It is said that all roads lead to New York. It is certain that New Jersey's highway system leads traffic to the Hudson River in an ever-increasing stream. The Highway Commission is constructing only the most durable pavements, which, in effect, will be city streets traversing the entire countryside, bringing the farms and producing centers ever in closer touch with the large cities. New Jersey contemplates spending approximately $6 000 000 during the summer of 1919 on State highways alone, in addition to which the counties will spend approximately $2 000 000 for new construction. As a sidelight on highway development as an adjunct or supplement to future railway development, the speaker quotes from a recent statement by C. A. Morse, M. Am. Soc. C. E., of the United States Railroad Administration:

"The perfection of the motor truck and tractor, together with the universal use of the automobile, has introduced a new element into the transportation problem that should be taken into consideration at this time, while studying the reorganization of the whole transportation question. Good roads are demanded for the use of the automobile, and a study should be made to see what additional expense would be necessary to construct them so that they would serve for motor truck and tractor. Where, heretofore, development of the country for 50 miles on each side of a trunk line of railroad has required the construction of light branch lines, it is a question to be seriously considered whether

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this policy should be continued or whether good wagon roads should be constructed and the products of farms, and passenger travel, should not be handled by motor trucks and automobiles to the main line. Taken alone and considered as a unit, practically none of these small branch lines pays expenses, but as gatherers of freight and passengers to increase density of traffic on the main lines, they are sources of profit. As, however, the traffic gathered by them is turned over to the main line with a deficit attached, which has to be overcome during the main line movement before any profit is made, it would be a decided advantage if this traffic could be delivered to the trunk line by means of the motor truck, tractor, and automobile without this bill of expense attached."

Noting the fact that thus one handling would be obviated, as it is now necessary to truck farm products to the short-line branch, and then transfer them to the main line, Mr. Morse continued:

"Investigation of this subject may show the desirability, as good roads are completed, of taking up many branch line railroads and utilizing the abandoned roadbed for improved motor roads, thus decreasing the expense of maintenance and operation of our railroads and giving in its place a well located motor road. Such a change would call for increased facilities at stations along the main line for passengers and for hauling freight, including storage, trackage, etc., but it would mean the concentration of supervision and labor, permitting better housing and living conditions for employees. Motor-driven conveyances have gradually been changing conditions of railroad transportation for the past ten years, and now that the general study of transportation facilities is up for discussion, it should be taken into careful consideration and due weight given to its influence on the economies of the situation."

From these quotations it will be seen that railroad managers are seriously considering the question of leaving to the highways the matter of caring for short-haul freight. Such a system would obviate the construction of short feeder lines, costly rehandling of freight, and result in more rapid delivery.

The motor vehicle laws of New Jersey are now very well defined. The maximum load allowed is 30 000 lb., assuming that approximately 75% of that load is carried on the rear axle. The speaker thinks that is higher than is allowed or contemplated by most States. The tire equipment is also regulated in accordance with the weight of the machine. The speaker thinks that the maximum now allowed is 800 lb. per in. of width of tire.

The regulations of the Motor Vehicle Department also restrict the height of trucks to 12 ft. 6 in., and the maximum width to 8 ft. The traffic regulations are also about to be enforced more rigidly, in order to provide greater safety on the highways. The Motor Vehicle Commissioner has fifteen or twenty inspectors who are patroling the roads

constantly, in order to protect the careful driver against infractions of the regulations. Mr. Thompson.

The question of determining a standard or a set of standards for the regulation of motor trucks to restrict their weight, size, and speed, is now under way, a committee having been appointed by the National Highway Traffic Association. This committee is composed of five State Highway Engineers and four representatives of the motor truck manufacturers and users.

The matter came up for report at the Annual Meeting of the American Road Builders Association, held in New York City, in February, 1919, when the committee made a Progress Report to the effect that the weights of motor vehicles should be restricted arbitrarily to 28 000 lb. gross weight of truck and load.

That met with considerable opposition, because of the fact that at present the statutory requirements in a number of States are much lower, running down to 24 000 and 20 000 lb. gross load. The question is debatable, as the decision depends entirely on arbitrary conclusions, because there is no definite data to determine how much more damage may be done by a 28 000 or a 30 000-lb. load than by a 5 000 or 10 000-lb. load; but it is hoped that during 1919 a common standard will be accepted, at least, for the North Atlantic and the Eastern States of the country, where the truck traffic is now the heaviest.

Probably the matter will be settled eventually on a basis of about 25 000 lb. That was demanded by the highway builders and highway authorities, and an attempt was made to show to the motor vehicle owners and motor vehicle manufacturers that unless there was an arbitrary decision, the agitation in communities having to pay for those roads would be such as to compel them to adopt a lower standard. For example, the Legislature of Pennsylvania had a bill before it restricting the weight to 24 000 lb., which would have compelled trucks which could be used in New Jersey up to 30 000 lb. to stop at the Delaware River; and, of course, that would interfere with the free movement of interstate truck traffic.

New Jersey's law is in operation now, and an effort is to be made—a very effective effort—to see that trucks do not exceed that load, because the inspectors will compel the weighing of occasional trucks which seem to be too heavy. If they are over weight, the owners will be fined for disobeying the law.

H. Eltinge Breed,* M. Am. Soc. C. E.—The present is the point of departure. Before discussing concrete details of future development, an attempt will be made to state briefly the present conditions. The war has given a tremendous impetus to all the sciences. The economic situation stresses to-day as never before the necessity for ampler, fairer methods of production and distribution. Engineers have a mass Mr. Breed.

* New York City.

Mr. Breed. of definite scientific data behind them, and the needs of a world before them.

Highway work has now reached the adolescent stage. Its infancy lasted more than 100 years, about 90 of which were spent in one long nap. Under Jefferson's administration the National Government and a number of the States started a road-building programme. The Government built a few hundred miles of roads and the States a similar number. Shortly after starting this programme, all road building on the part of the National Government and the States ceased. The work was then taken up by many turnpike companies, which built a number of roads in the Eastern States, operating them under the toll system. After the establishment of the toll road came the "nap". Road construction was handled principally by the township and county officials, with no development in types of construction or methods of maintenance, outside of large cities. This condition continued until the late Nineties. Then came the bicycle craze and active propaganda on the part of the League of American Wheelmen for better roads. Before this died out, the automobile had come to stay. As the number of cars increased, the great concern was the dust nuisance. Oil was applied and bituminous binders were used, but, almost before they were on, the old earth and light gravel roads beneath them had begun to disintegrate. The road builder's problem was growing, and he tried to solve it by constructing a better surfacing for the macadam types. That did not last long, as the increasing weight and speed of vehicles, and a few spring thaws and freezes, broke it up.

This also affected the tax-payer's money, for, by this time, the various States had taken up the matter of road building, with subsidiary county and township systems. In New York State the Legislature of 1898 passed two Acts, the Fuller-Plank Act, providing that the State would duplicate for each town whatever amount it raised for highway purposes; and the Higbie-Armstrong Act, appropriating $50 000 for roads to be improved—50% by the State, 35% by the county they were in, and 15% by the townships. Each year after that the annual appropriation for highway work grew, until, in 1904, it was $1 108 000. Yet there were only about 300 miles of even average good roads.

Some saw that it was time to call a halt, and cried, "This road building is no job for political henchmen; it is no game for amateurs. We need trained men. Give us university courses for Highway Engineers. Give us laboratories for experimental work. Above all, let us start at the beginning, plan our routes, abandon cow-trails, and build our roads from the bottom up."

That happened about 1903. Since then road engineers have been trying to keep up with traffic, like a child chasing a rubber ball down hill. They had almost caught it, when, suddenly, came the motor truck. Loads of 15 or 20, and even 30, tons were carried on roads designed

to endure 5 or 6 tons, and the roads broke down. Before this policy could be re-shaped, war was declared, and motor trucks were being built in great numbers in order to supplement the work of the railroads. Maintenance on the route along the east bank of the Hudson between New York City and Albany for 1917 cost $215 200.74, in comparison with an expenditure of $115 816.56 in 1915, showing an increase of almost $100 000, due to heavier motor truck traffic; but the roads were kept open for traffic, and there was no cessation of men and supplies between Buffalo and New York City. That, and the fact that to-day there are in New York State 7 200 miles of improved roads and 15 completed routes, north, south, east, and west, through the State, is a measure of the success attained. This, however, has been extravagant beyond measure, in money and energy, and has been smirched with failure. Politics have not been kept out of highway work. Some through routes lack important links, because, instead, spurs have been built to the homes of influential politicians. The work has not been kept out of the hands of amateurs—the roads are full of them, and will be until highway work pays bigger salaries and demands higher skill. Engineers have not done enough laboratory work. Instead, they have been prone lazily to trust the statements of the material interests, and this costly experience has not always been uncolored by commercial fiction. Only now are they beginning to understand what the term "foundation" really means. Mr. Breed.

The speaker has said that highway work has now reached adolescence: First, because a clear perception of the problem ought to mean that engineers have outgrown the errors of infancy.

Second, because public sentiment is solidly behind the idea. It has been created in the only real way, by the discernment of the people themselves that they must have good roads in order to be fully a part of the world in which they live, and has been formulated by the well-conducted campaign of good roads and automobile organizations, motor truck, and material interests.

Third, because the money has been provided, and more is coming. The Government has appropriated $200 000 000 as Federal aid to roads, and is planning to provide another $400 000 000 for National systems. New York State is on its second $50 000 000 bond issue. Illinois and Pennsylvania have just raised $50 000 000 and $60 000 000, respectively, and other States are rapidly falling into line. If these moneys are expended economically, no shortage of funds need be feared.

Fourth, because the people have reached the psychological condition which characterizes adolescence, namely, self scrutiny and analysis.

What is meant will be explained in terms of types of pavement. On January 1st, 1918, there were, in New York State, 6 912 miles of pavement, of which 5 820 miles were non-permanent types and 1 092 miles were permanent; of the latter all but 129 miles were of brick or concrete.

Mr. Breed. The non-permanent types are water-bound macadam and bituminous macadam by the penetration method.

*Water-bound Macadam.*—This pavement is best adapted to the needs of light traffic, but has no place on any through route. It costs to-day about $23 000 per mile for a 16 to 26-ft. pavement, 9 in. thick (that is, a 3-in. top on a 6-in. sub-base). Low construction cost has been the greatest advantage. Its greatest disadvantage now is its high cost of maintenance, which, in 1917, amounted to $970 per mile. The average life of a pavement of this type is 7 years for a traffic of less than 1 000 tons per day. Many water-bound roads have worn out in from 1 to 3 years when required to carry a heavier tonnage.

*Bituminous Macadam. Penetration Method.*—This type is also adapted to light traffic, generally, and is advantageous in many localities where the only stone available is non-binding. Among its disadvantages is its tendency to creep under traffic. It is slippery when wet; has a fairly high cost of maintenance—$412 per mile during 1917—and a construction cost of $28 500 per mile for a 16 to 26-ft. pavement, 9 in. thick (that is, a 3-in. top course and a 6-in. sub-base bottom course). The average life of this type is 2 years more than that of water-bound macadam under similar traffic conditions.

The determination given for the average life of the foregoing types was made in 1917. The much heavier traffic tonnage of to-day would shorten it considerably.

The following are classed as permanent types:

*Concrete.*—This pavement has the disadvantage of a glare. It has the advantage of low first cost—$31 200 per mile to-day for a 16 to 26-ft. pavement, with an average thickness of 6 in. Its maintenance in 1917 was $112 per mile. Its average life, thus far, can only be estimated, but, judging from the condition of pavements of this type, from 5 to 9 years old, with which the speaker is familiar, it is, say, at least 15 years.

*Brick Pavement.*—Brick pavements of the sand-cushion type have not been entirely satisfactory for country roads in this climate. One disadvantage is the shifting of the sand cushion, with the consequent settlement, breaking, and spalling of the bricks. The speaker cannot give present-day costs, as the State has ceased to build brick pavements, except as semi-monolithic and monolithic structures. The cost of maintenance was $222 per mile in 1917. The average life, of course, can only be estimated, but, from present indications, it might be placed at not more than 12 years.

*Brick Pavements. Semi-Monolithic Type.*—This type differs from the original brick pavement, in that there is no sand cushion, the bricks being laid in a cement-sand bed and treated with cement grout so that the bed forms an integral part of the pavement. This type has the advantage of developing beam strength, as in concrete pave-

ment, and it eliminates the shifting of and depressions in the brick. Its cost under present conditions would be about $50 600 per mile for a 3-in. brick on a 4-in. concrete foundation. The speaker has no maintenance figures for this type, as the State has been building it for only a little more than a year. Mr. Breed.

*Brick Pavements. Monolithic Type.*—This type differs from the semi-monolithic in that the bricks are set in a green concrete and treated with a cement grout so that it forms an integral part of the pavement. This type develops the full beam strength, and has even greater advantages than the semi-monolithic type, so far as strength is concerned. It is more difficult, however, to get as smooth a surface as can be obtained with the semi-monolithic type.

*Asphaltic Concrete.*—In order to insure a nearly smooth pavement, a smooth concrete foundation should be provided. These pavements have the disadvantage of pushing under traffic from future consolidation, if the aggregate is not properly sized and proportioned, or if it contains too much bituminous material. However, if too little of the latter is used, the pavement becomes dry and soon disintegrates. The ideal mix is one in which the motor oil dropped from cars renews the volatile oils lost. These pavements cost about $40 000 per mile (depending on the type), with a 2-in. top and a 5-in. concrete foundation. Their maintenance cost in 1917 was $245 per mile.

There are many patent pavements which come under the classification of permanent types and are good.

It is apparent that engineers know, with a fair degree of precision, what service such roads as these, built as they are to-day, will give under present traffic. With this knowledge, which was entirely lacking even 10 years ago, the speaker thinks they are prepared to emerge into real maturity. However, there is one proviso, namely, that no load on the roads shall exceed a given weight. In this restriction they should be guided, for 5 years at least, by the experience of the past. The slight chance that it may be a limitation is more than offset by the absolute assurance that it will be a safeguard to the roads.

The motor truck marks a distinct transition in transportation facilities. It has made the highway as available for freight haulage as the waterway and the railway. The service of the motor truck in the freight crisis of the past year established forever the importance of the highway as an integral part of the transportation system of the United States. Thus far, however, it has been fatal to the very factor on which its usefulness depends—it is the greatest destructive force the highway has ever encountered.

The latest traffic reports, on fifteen highways in various parts of New York State, show an increase in truck tonnage varying biennially from 50 to 400%, and, in 1918, an average increase of 150% over the

Mr. Breed. tonnage of 1916. To try to build highways to keep pace with a continuous advance of that kind would bankrupt the public.

The wiser motor truck manufacturers have themselves adopted the broad policy of selling transportation service, rather than the exclusive one of selling motor trucks. These men, who have had every opportunity to study the economics of the problem, have agreed on the desirability of the 5-ton truck as a standard unit. This should now be established by law, and the highways should be designed to meet it. It will mean a total maximum load of about 12½ tons, of which approximately 9 tons should be applied to the rear axle. There should also be general regulations for other destructive factors, such as inadequate tires and springs.

Engineers can build roads economically for the 5-ton truck, but cannot afford to have them disrupted by a few excessively large trucks. Nor should they be designed extravagantly to meet the requirements of a few individuals. The maximum loading must be restricted to the economic standard suggested by the manufacturers and desired by the majority of truck users. Then will the highway be able to give to the motor car and to the community its most efficient service.

Probably in every other line of engineering there is some such restriction, based on a fundamental and enduring economic law of relative values. Beyond that, however, engineers can plan for the future with imagination unfettered by any narrow limits of probability.

The speaker believes that the country, during the next 5 years, will be criss-crossed by myriad lines of communication: Waterway, railway, highway—the trinity of transportation. Great cities along the first two—centers of world-wide distribution. Feeding them, the highways with motor trucks incessantly going back and forth 10, 15, 20 miles, to centers of production, flourishing agricultural and industrial towns. Manufacturing will be more and more forced out of the big cities, through pressure of space, and into the surrounding country, where the much cheaper rentals will be more than an offset for the slightly greater carrying charges. Highway and motor truck make this feasible, and independent of railways.

Farming must be encouraged if the people are to live, and the speaker sees the highways as a great means of encouragement to the production of farm wealth. They will help banish from farm life its deadly isolation; they will make possible community towns, from which outlying farms may be worked. They will help attract men back to the land, and then, with the motor truck, help them market their products with less intervention by profit-taking middlemen.

The trunk roads from the great cities to the smaller towns, the subsidiaries leading from them through the more rural regions—all these will be united in great systems that will provide through and uninterrupted passage from any place in the country to every other place.

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Guiding this work of co-ordination, there will be, in Washington, a National Highway Commission, second in importance only to the Cabinet Departments. Beyond the proposed Lincoln Highway, that Commission will have under construction, or completed, before 1925 at least four other transcontinental highways, planned solely from the standpoint of highway economy, without reference to existing cities and towns. Given the roads, the population will settle along them, just as it has along the railroads. Throughout history civilization has always followed the lines of communication. At first, Nature determined these lines; now they are determined by Man.

Meanwhile, each State has been perfecting its own system within its borders, building through routes between its important points, with whatever spurs are necessary to connect with the National system and with similar routes in adjacent States; and the counties have helped, with feeders to these routes from every remote village and hamlet, until all are sharing to the fullest extent in the surge of national life.

With such development for the highways, with the suggested improvement of the waterways, and the hoped for resurrection of the railways, the transportation facilities of this country 5 years hence ought to be more than adequate to meet the demands on them.

So much for the vision—akin to what every one probably holds for his own special line—now for the toil to make it real.

First of all, in every line of engineering, one must work for greater permanence in result. Europe has proclaimed that lesson, but this country has not heeded it. With the vigorous impatience of youth, stability has been sacrificed to speed, size has been acclaimed rather than soundness.

The public must be roused to demand that engineers build deep and well. They must learn to spurn the shoddy, beloved of their politicians. Last week a delegation from an up-State county came importunate to the Commissioner's office in Albany. "Gentlemen," he said, "I want you to have these roads, but I have exactly $300 000 to spend in your county. Would you rather have 10 miles of good road that will last you 15 years without ever having to be closed for repairs; or 20 miles of poor road that may last for 3 years and will have to be closed often?" With one accord they cried, "Give us the 20 miles."

At the speaker's remonstrance, one member of the delegation said, pityingly: "The counties want the roads. The cheaper they are, the more we get for our money in them. The State has to do the maintaining, and most of the State's taxes are paid by New York City. What is our worry about permanence?"

It is a worry, however, that engineers cannot dodge. The National routes should have foundations at least comparable with the best railroad practice, and be surfaced with one of the permanent types—the choice depending on the materials most available in a given locality.

Mr. Breed. The State routes should have the same surfacing and strength of foundation. Within a 30-mile radius of the large cities, the foundations must be still further deepened and the pavement widened to sustain the heavier traffic. The county roads should have a semi-durable surfacing, according to the need shown by a traffic census, and a proportionately good foundation, except within 20 miles of the larger towns, where they should again be of permanent type.

So much for the basis of permanence. There are many other factors in a roadway, however, besides foundation and surfacing. They come under the heading of "details", through closer attention to which, engineers, in every line, may find opportunity for much improvement. A few may be mentioned which are of fundamental importance in highway work, and yet have hitherto received rather cavalier treatment.

*Width of Roads.*—The least width for National roads and most of the State routes will be 20 ft. for the pavement proper, with an additional 5 ft. or more for the shoulder; that is, where traffic density requires only two tracks; for each additional line of traffic, there should be an additional 9 ft. of pavement. On a few State roads, where traffic is lighter, and most of the county roads, there will be a 10-ft. pavement of hard surfacing and beside it 10 ft. more of earth road which may be improved when necessary to make the full two-line traffic pavement.

*Alignment and Grades.*—Although the straight line shortens the distance, curves are often necessary in order to conform to the broken topography of the country. This matter of alignment and grade will receive more careful study in relation to economizing the fuel used in the propulsion of motor vehicles. All curves should be reduced so as to afford a sight distance of 600 ft. Where that is impossible, the curves may be split by a parking place or posts in the center so as to divide the traffic. Buildings will be removed from dangerous corners, and banks graded back; and, wherever possible, curves will be widened so as to secure greater safety for passing vehicles.

*Drainage.*—No matter how well a road has been drained, its use generally shows that more drainage is necessary. Ditches must be widened as foundations are deepened. Only by keeping the subsoil dry can it act as part of the foundation, cheapen the cost of the pavement, and insure coherence of crust during wet subsoil conditions. The speaker foresees the return of the deep ditch far enough away from the roadway proper not to imperil the traveling public, and providing run-offs and lateral systems to drain away the sub-surface water.

*Marking of Routes.*—Is it Utopian to hope to have, at every turn, adequate sign-posts which one can read when going at a speed of 10 miles an hour? There is no doubt that there will be general acceptance of the banding of poles in different color schemes to indicate main

traveled routes, so helpful has this procedure proved in New York and the New England States. Mr. Breed.

*Esthetic Features.*—An ugly sign-post is a public offense, so is the billboard and the unnecessary danger sign. They will not be tolerated. On the other hand, the furtherance of the Arbor Day and patriotic memorial idea will enhance the beauty of the roadways with shade trees and shrubs, and parking spaces must be provided at definite intervals, and also the sorely needed rest and comfort stations. A greater length of culvert and the general use of the straight line in its design will obviate the need of unsightly guard-rails around its ends. The use of boulders and rustic guard-rails will be an improvement over the ugly painted wooded affairs now used, and they will also be cheaper.

*Letting of Contracts.*—Because of the greater quantity of work to be done and the scanty number of contractors to do it, there is need for encouraging large construction organizations to enter the highway field. This will mean ultimate economy. A large number of contracts will be left in lengths of from 15 to 30 miles, justifying the use of special equipment and special labor-saving devices, such as the short contracts cannot warrant, because of the disproportionate overhead charge. The most adequate equipment is necessary to-day to supplant the rapidly diminishing quantity of hand labor.

*Maintenance of Traffic.*—Many of the old roads will have to be reconstructed in order that they may take their place in the new systems. Experience in New York State has shown that where a semi-durable pavement has broken up because the weakness of a soft and yielding subsoil has been accentuated by heavy traffic during the spring thaws, it has been cheaper in most cases to fill the broken gaps with a rigid type of pavement—of concrete or with a concrete base—rather than go to the expense of deeper excavation for extra drainage and for extra thickness of sub-base foundation under the old type. These gaps then become a permanent start toward the reconstruction of the whole road.

In building pavements of the widths proposed, it will be possible to build one longitudinal half at a time, and thus provide for a long-suffering public that has been discommoded with insufficient detours.

Thus, are suggested some of the possible developments of the next 5 years. Their practicability to each engineer depends on his experience, viewpoint, and temperament. They may not prove practical at all. Then they must be modified or changed. That is of less concern. What greatly matters is, to be free from too close dependence on the past, to see the future with larger vision, to apply permanence as the one standard of success, and to give to details the devoted attention of artists and scientists. These traits, sought in common, will

Mr. Breed. strengthen the alliance among us all, and, to these traits, the speaker believes, will be due the greatest good that may come from the highways of the future.

In reply to the inquiry as to the comparative merits of tar and asphalt in surfacing, the speaker finds it difficult to generalize. There are certain kinds of stone in New York State, such as gneiss, from which the best results have been obtained with tar. There are other rocks, like trap, from which the best results are secured with asphalt.

This can probably be explained better by saying that tar has a tendency to go down through the rock. The gneiss rocks are more friable, and hold the tar up better, but with them asphalt has a tendency to work up or bleed—this is a condition which probably all know—if it has not thoroughly penetrated. With the harder rocks, it is found that asphalt gives the best surface, because it penetrates the interstices.

The tendency of tar to go down often makes it necessary to surface treat the road with cold tar and fine stone, sand, or gravel. If this is not done, the surface will soon become toothy and pitted.

Mr. Stern. EUGENE W. STERN, M. AM. SOC. C. E.*—The preceding speakers have not exaggerated in the least the importance of the highway problem in the United States. It is a very live subject, and one that demands the fullest discussion and propaganda for enlightenment.

It is hoped that this Society will take a much more active part in the propagation of information on this matter than it has in the past, and that it will encourage, in every way, meetings for the discussion of all matters pertaining thereto.

In America, with few exceptions, road problems have not been attacked with proper vision and boldness. Macadam roads have been built, when hard paved surfaces should have been laid. Paved surfaces have been too narrow, curves have not been easy enough, grades have been too steep. Drainage has been neglected, shoulders have been neglected, and, most important of all, proper upkeep has been neglected.

There have not been generally adopted proper regulations limiting the size, wheel loads, etc., of vehicles. Organization and administration of highway bureaus have been niggardly, poor, inefficient, and utterly behind the times. There has been lack of comprehensive plans, and of co-ordination in linking up highway routes; and, lastly, there has been too much politics in the entire highway problem. The foregoing deficiencies are causing the loss of many millions of dollars annually to the taxpayers, and they are all easily preventable.

Some experiences on road work in France, where the writer served for more than a year with the A. E. F., may be of interest.

* New York City.

Mr. Stern.

The administration and organization of the French road bureau is all under civil service rules, and is efficient and excellent to the highest degree. Politics does not enter into it. All road officers are trained engineers, graduates of the École Polytechnique and of the Ponts et Chaussées, and are retired at the age of 62 on a pension.

The organization for maintenance and repair is very thorough, and is admittedly the best in existence. Men called *cantonniers* are stationed along important roads at distances of from 3 to 6 km., living in little houses along the roads. They are at work continually, and never allow the roads to get in poor condition. Even if there is wear, the repairs are so skillful that the surface wears down smoothly.

British road officers have told the speaker that the roads in France are maintained at much less expense than in Great Britain, owing to the better organization.

Even in war times, it was surprising to see how well their organization functioned, though, of course, it was impossible to do the work as well as in peace times, as men and materials were often not available. Women and old men maintained the roads, back of the zone of operation of the armies.

French roads are thoroughly drained, every precaution being taken to carry away the water, and keep the sub-base dry. All roads have side ditches, and the National roads likewise have gutters, draining into the side ditches. The ditches and gutters are kept scrupulously clean, the grass being close-cropped, and the bottoms kept smooth. The water in the ditches is always kept flowing.

Shoulders are grassed, and trees are planted on both sides, and serve a double purpose, absorbing the excess moisture from the shoulders, thus tending to prevent frost heave, and, of course, the trees add very much to the beauty of the road.

Nearly all French roads are water-bound Macadam, the important roads having a Telford base, only a small percentage being paved with granite, or treated with tar. They are wonderfully well built, the greatest care being taken in every detail of their construction. The Macadam surface is made with one-size stone, $2\frac{1}{4}$ to $2\frac{1}{2}$-in. trap or granite, most thoroughly consolidated with a heavy roller, usually weighing 17 tons, the stone being kept thoroughly wetted during the process of rolling. The roller passes over the surface from 150 to 175 times, and, when the job is done, the surface is so thoroughly consolidated, and the stones so interlocked, that it looks like concrete. Regardless of the great excellence which the French have attained in the building of Macadam roads, however—probably the very best of their kind in existence—the war proved beyond any question that they are not suited for motor vehicle traffic. Shortly after the motor trucks of the U. S. Army commenced to use these roads extensively, they wore out rapidly, becoming full of holes and ruts. It required a

Mr. Stern.

great deal of labor and huge quantities of stone to keep them at all serviceable.

If there had been hard paved surfaces on the main highways in France during the war, millions of dollars would have been saved, and a great burden on the railways and canals would have been avoided, as about 40 000 tons of road stone had to be transported daily for the use of the armies on the Western Front alone.

In France, before the war, few motor trucks were used, and these mostly in the cities, or for a short distance outside. When war came, this situation changed almost over night. Every available motor vehicle was requisitioned, and the traffic developed by leaps and bounds. The motor truck saved France.

The French road engineers, although capable men, and not lacking in vision, had an entirely new problem to meet, but they could not improve the road surfaces in war time. It was too late. They were compelled to use Macadam for all repair and new construction, and now they are frank in admitting that it will not meet the necessities of the future. The upkeep costs far too much.

In the United States, the great question today is—"How can we best meet the road problem?" The speaker believes that it can be solved as readily and efficiently as other engineering problems, if it is attacked in the right way.

First.—Road building must be taken out of politics, and put in the hands of capable men. Highway commissioners should be able engineers, of thorough training in road work, who possess vision and force of character, combined with administrative and executive ability of a high order. It has been only too common for highway commissioners to be politicians, lawyers, or of any class not meeting the above requirements.

Second.—The remuneration and conditions surrounding the service should be made sufficiently attractive to induce professional engineers of a high grade to follow this calling. An engineer in responsible charge of road planning and construction should have certain qualifications. Besides technical knowledge, he must have vision—imagination for the future—balanced by good judgment. If he does not have this, and the courage of his convictions, he is in a position to waste huge sums of the taxpayers' money. His decision alone, as to what type of wearing surface should be used, may mean great saving or loss to the community.

There is an example of this in New York, and in many other States, where Macadam roads have been built in recent years, when every indication pointed to the lesson that surfaces of this type would not stand the growing motor vehicle traffic. The result is that there are many thousands of miles of Macadam roads costing annually for upkeep alone more than $1 000 a mile, whereas, had a road of proper

type been built, the annual gross cost to the taxpayers would have been almost cut in half. By annual gross cost, the speaker, of course, means interest on the cost of construction, plus amortization, plus annual upkeep. Mr. Stern.

The speaker has only touched on the more important considerations in the solution of the road problem, as he believes these to be fundamental. Given proper organization and leadership, the rest will follow.

Calvin Tomkins,* Assoc. Am. Soc. C. E.—The speaker calls attention to two or three points which have impressed him in the discussion of this interesting subject. On the New York side the highway system is completed, and also beyond the meadows district in New Jersey, where there is an excellent system radiating from the Passaic River; but, in the intermediate meadows district, there is lacking any kind of road system, or any plan, so far as the speaker knows. There are three principal roads crossing the meadows, and no adequate transverse roads running north and south between them, as there should be. Before industrial development proceeds to any great extent in this territory, a general plan of road construction should be adopted, in anticipation of the needs; otherwise it will be necessary, in the future, to go to very great expense in order to provide a suitable system. The roads should converge on the meadows as much as possible at a few crossings on the Hackensack and Passaic Rivers, so as not to interfere with the river traffic any more than can be helped. This interference of water and land traffic has already become a serious problem. Mr. Tomkins.

The speaker doubts the advisability of building a bridge over Newark Bay, as the latter is second in importance only to New York Bay, as a part of the Harbor of New York. In its present condition it is a shallow body of water, and of little use; but it can be dredged, and at far less expense than that incurred at Bremerhaven, Glasgow, or Hamburg, and made a most important adjunct to the harbor. Bridges across it will interfere seriously with its navigability.

The speaker believes the time has come when a system of tunnels under the Hudson should be planned in advance. These first vehicular tunnels are only the precursors of many which will be built, and the lay-out of the system should be such as to prevent interference. The conditions in the bed of the river are known, and it is of the greatest importance to leave those conditions so that many tunnels can be constructed. The speaker has been informed that there is in existence a plan for an Erie Railroad river tunnel, running diagonally across the river, which, if built, would interfere seriously with future east and west tunnels.

* New York City.

Mr. Tomkins.

Mr. Thompson's remark relative to the utilization of small unprofitable railroad feeder lines for highway uses is important. Highways have demonstrated their efficiency as feeders for the railroads. The small railroad lines are not economical, and, just as trolley construction has been stopped by the building of good roads, so feeder railroad lines will be stopped, and many of them can be used advantageously as highways.

However important vehicular tunnels may be for communication between New York City and New Jersey, one should not lose sight of the fact that the fundamental needs are railroad tunnels. They are needed as soon as they can be built, and a strike would be a fortunate rather than an unfortunate occurrence for New York City if it helped to demonstrate the absolute necessity of establishing physical all-rail connections with the great continent to the west.

The newspapers state that only 20% of the population of Petrograd remains. The rest have been starved out because of the desperate consequences of the interruption of railroad traffic. The same causes may eventually produce like results in New York City unless continuous railroad service can be maintained with the continent. At present, there is only the intermittent railroad lighterage car-float services across the harbor, and the traffic will be interfered with continually by labor disturbances, because the harbor transfer is the weak link in the system, and will be the point of attack every time a railroad dispute arises.

# MEMOIRS OF DECEASED MEMBERS

NOTE.—Memoirs will be reproduced in the volumes of *Transactions*. Any information which will amplify the records as here printed, or correct any errors, should be forwarded to the Secretary prior to the final publication.

## RALPH HENRY BROWN, M. Am. Soc. C. E.*

DIED FEBRUARY 22D, 1919.

Ralph Henry Brown was born at Canfield, Ohio, on August 1st, 1860. He was the son of Richard and Thalia (Newton) Brown. His grandfather was a British officer who fought in the Battle of Waterloo, and was descended from English yeomanry ancestry. Richard Brown was born in England in 1818. He served his apprenticeship as a "draper" in London, and was engaged in business in that city and in Paris. Together with George Williams, a fellow employee, later knighted by Queen Victoria, he organized the first Young Men's Christian Association in the world. He came to the United States when twenty-one years of age, entered the employ of A. T. Stuart and Company and remained with them until about 1853, when he established himself in the dry goods business. While thus engaged he, with Messrs. William E. Dodge and R. R. McBurney, organized in New York City the first Young Men's Christian Association in this country, and became its first Treasurer. Ralph's mother was born in Ohio, of parents who had moved there from Connecticut as early settlers in that portion of Ohio known as the Northwest Reserve.

Ralph's early education was obtained in the Collegiate School in New York City, the Grammar School at Mount Vernon, N. Y., the High School at Canfield, Ohio, of which he was a member of the first class graduated, and, later, at Wooster University, Wooster, Ohio.

From July to October, 1881, he served as Rodman and Transitman on a short extension of the Painesville and Youngstown Railroad, and for the following year was employed in the office of James M. Reno, City Engineer of Youngstown, Ohio, on city and farm surveying and in coal mine work. In 1883, he established a private practice as a Land and Mine Surveyor at Youngstown, but feeling the need of more specialized education, in the fall of that year he entered the Thayer School of Civil Engineering of Dartmouth University, at Hanover, N. H., and was graduated therefrom in March, 1885.

Immediately after his graduation, Mr. Brown entered the employ of the Boston Bridge Works as Assistant Engineer, and for the next 15 years continued his connection with this Company, for 6

* Memoir prepared by J. R. Worcester, M. Am. Soc. C. E.

years as Assistant Engineer, 3 years as Engineer in Charge of the Estimating Department, and from 1894 as Chief Engineer. During his term as Chief Engineer, the Boston Bridge Works designed and built, among many structures of lesser importance, highway bridges over the Merrimack River at Newburyport, Mass., over the Kennebec River between Fairfield and Benton, Me., over the Back River at Portland, Me., many railroad bridges, and the steel framework of many important buildings, such as armories, industrial plants, storage buildings, and hotels.

In 1900 he associated himself with Mr. A. S. Miller, Jr., in organizing the Eastern Bridge and Structural Company, of Worcester, Mass., and during the remainder of his life devoted himself exclusively to fostering and building up this company. Mr. Brown was a skillful and ingenious designer. Thoroughly grounded in the science of structures, he was intimately acquainted with the practical applications of the art, and able to devise new methods to accomplish his ends. He was always interested in economizing material and labor, and was able to effect many important savings for his clients. Though chiefly concerned with steel construction, he was alive to the uses of other materials. Largely by his ability and untiring industry, the Eastern Bridge and Structural Company has built up an enviable reputation among the users of structural steel in the eastern section of the United States.

Mr. Brown was first married in August, 1889, to Miss Ella Gertrude Gardner, of Brockton, Mass., who died in 1906, leaving a son and a daughter. He was married a second time, to Miss S. F. Palmer, only about two months before his death, which occurred on February 22d, 1919, from a sudden attack of pneumonia.

Mr. Brown was naturally retiring in his disposition and not inclined to enlarge his field of activities beyond his business associations. He was a member of the Engineers' Club of Boston, and the Worcester and the Dartmouth Clubs, of Worcester. During the last ten years of his life he took an active interest in Masonry. He was a Knight Templar and had taken nearly all the Scottish Rites Degrees. He was always a hard and persistent worker, and was just beginning to look forward to a time when he could enjoy more ease. The little time he allowed himself for recreation was spent at his summer cottage in Rutland, Mass., where he took great pleasure in hunting and fishing.

He was greatly beloved by his associates, and had few if any enemies. He had a keen sense of humor, and his hearty, bluff, sincere manner secured him a cordial welcome wherever he went.

Mr. Brown was elected a Member of the American Society of Civil Engineers on June 7th, 1899.

## JAMES HAYWARD HARLOW, M. Am. Soc. C. E.*

Died October 6th, 1918.

James Hayward Harlow, was born in Westminster, Worcester County, Mass., on September 30th, 1846. He died at his home at Darlington, in the 5th District of Harford County, Maryland, on October 6th, 1918. Like many another of the old New England stock, he could trace his ancestry to the *Mayflower,* being the tenth in descent from Richard Warren and the ninth from John Alden and Priscilla Mullins.

His father, Noah R. Harlow, was a civil engineer, and was engaged on the location of the Nashua and Lowell Railroad, one of the first roads built in the United States. Later, he was Assistant Engineer in charge of the Fitchburg Division of the Vermont and Massachusetts Railroad, and, in 1854, Chief Engineer of the Terre Haute, Alton and St. Louis Railroad. In 1856 he returned to Massachusetts and for much of the time until his death in 1892 was Engineer and Paymaster of the Proprietors of Locks and Canals, at Lowell, Mass.

His mother was Sarah Ann Hunt, daughter of Asa and Maria F. (Hollis) Hunt. She died before he was a year old, and his father married Sarah Caroline Howe. Under her charge he never lacked a mother's love and care.

As a boy James Hayward Harlow was not strong, and attended school but little, having been taught at home. His mathematics he acquired by private study, and his primary engineering knowledge by helping his father. In 1863, he worked in a small machine shop in Leominster, Mass. While here he gained such skill in the handling of tools that, later in life, when he did a little filing, the machinists remarked that he had done that thing before and knew how to hold a tool.

In 1864 Mr. Harlow's family moved to Lowell, Mass., and he was employed for about a year in the office of the Proprietors of Locks and Canals. In 1865 he commenced his engineering work in the employ of the Franklin Company, at Lewiston, Me., the corporation owning the water power of the Androscoggin River. He remained there two years. In 1867 and 1868 he was at Davenport, Iowa, in the employ of the United States Government, on the improvement of the Mississippi River. In 1869 he was under Gen. Rodman, in the U. S. Arsenal at Rock Island, Ill., and he also spent some time in this vicinity on a railroad survey. In 1871 he returned to Lowell and was Assistant Engineer in charge of laying the pipe lines of the original plant of the Lowell Water-Works. In 1872 he was Assistant Engineer in charge

* Memoir prepared by George R. Harlow, M. Am. Soc. C. E.

of laying the pipe lines for the "new" water-works at Pittsburgh, Pa., and remained there until May, 1874.

Mr. Harlow then opened an office in Boston, with the late Gorham P. Lowe, M. Am. Soc. C. E., as partner, but this partnership was dissolved in 1876. For the next two years he was with the engineering force on the Metropolitan Water Supply, being at South Framingham, Mass., for much of the time. In August, 1878, he was appointed Assistant Engineer under Lieut. Mahan, who had charge of building the Davis Island Dam, in the Ohio River just below Pittsburgh. The pool made by this dam extends to Dam No. 1, on the Monongahela River, and makes a harbor for the coal boats at Pittsburgh. Under Mr. Harlow's supervision, the lock walls were built and the foundations for the dam commenced. The appropriation having been spent, he was asked to resign in January, 1880.

Again he opened an engineering office, this time in Pittsburgh, Pa., where he made his headquarters until he moved to Maryland, in 1902. He helped to organize the New Castle Water Company in 1881, and designed and superintended building its water-works at New Castle, Pa., in 1881 and 1882.

From 1881 to 1885 Mr. Harlow was Chief Engineer of the Monongahela Navigation Company, in charge of the construction of the dams and locks on the Monongahela River. Under him the new Dam and Lock No. 7 and the second lock at Dam No. 3 were built. In 1884, he was made President of the Water and Gas Works Construction Company, with offices at Pittsburgh. This Company built the water-works at Elkhart, Ind., in 1884, Eau Claire, Wis., and Mattoon, Ill., in 1885, and Latrobe and Mercer, Pa., in 1886. In this latter year they built a large gas pipe line through some of the principal streets of Pittsburgh. This contract was disastrous, and the Company was dissolved in 1887. In this year he entered into partnership with his two younger brothers, George R. and Edward J. Harlow, under the firm name of James H. Harlow and Company, Engineers and Contractors. They built water-works in Canisteo and Port Henry, N. Y., Tarentum, Etna, Waynesburg, Millvale, and Homestead, Pa., and Annapolis and Bel Air, Md.

In 1888, Mr. Harlow acquired the charter of the Pennsylvania Water Company, the company which now supplies the municipalities adjoining Pittsburgh on the east. Under his management, the capitalization of this company grew from $300 000 to $2 250 000. In 1889, when the works were first built, there were 14 miles of pipe lines, none larger than 16 in. In 1902 there were 102 miles of pipe lines, including about 3 miles of 42 and 36 in. In this latter year he sold his interest in the corporation to the Mellons, of the Mellon National Bank of Pittsburgh.

In 1894 Mr. Harlow's attention was called to the water-power possibilities of the Susquehanna River between Columbia, Pa., and its mouth. From being an engineer he became also financially interested in acquiring properties along its shores. He and his associates sold their holdings in Pennsylvania to the builders of the dam at Holtwood, now operated as the Pennsylvania Water and Power Company. In 1915, this company delivered in Baltimore 343 000 000 kw-hr. of electric power.

After 1904 Mr. Harlow resided at Darlington, Md., and was Chief Engineer of the Susquehanna Power Company, which controls the Susquehanna River from the tail-race of the dam at Holtwood to its mouth. When this part of the river is developed, it will produce twice as much power as that delivered by the Pennsylvania Water and Power Company in 1915. He owned all the capital stock of the Havre de Grace (Md.) Electric Company, and was its Treasurer. He also owned the electric plant at Perryville, Md., which he operated as the Perryville Electric Company. In addition to the enterprise just mentioned, his advice was sought and given in many water-power and other hydraulic cases.

Thus far, reference has been made only to Mr. Harlow's engineering work. While at the Davis Island Dam he was one of the organizers of the Engineers Society of Western Pennsylvania, and was its first Secretary, from 1880 to 1884, and again in 1891. He was a member of the Engineers Society of Pennsylvania, of Harrisburg, and of the Engineers Club of Baltimore. He was one of the founders of the Pennsylvania Water Works Association, had been its President, and, up to 1902, had served on its Executive Committee.

Mr. Harlow was one of the Charter Members in 1890 of the Edgewood Church, of the Pittsburgh Presbytery, and was President of its Board of Trustees until 1902. He was a member and supporter of Harmony Presbyterian Church, near Darlington, a member of Darlington Grange, the Darlington Good Roads League, the Darlington Civic Association, the Darlington Cemetery Company, and the Community Council of Defense, and organized the Darlington Creamery Company. His ability as a farmer is shown by the fact that when he bought his home place, of 32 acres, it would not keep three horses and two cows without having to buy feed; but in 1914 he built a large barn, and the place now sustains three horses and eight cattle. Mr. Harlow had served as Foreman of the Grand Jury of Harford County, and had investigated rumors of misdoings among the officials, to the satisfaction of the Court and County.

These connections show how widely his interests extended. How he was esteemed by his associates is shown by the following memorials presented after his death.

The Pennsylvania Water Works Association said:

"And because of his genial, lovable personality, his presence was always welcome."

The Directors of the Baltimore County Water and Electric Company said:

"The Board of Directors have had taken from their number a sincere and beloved friend and adviser, whose broad experience and ripe judgment was ever sought and relied upon. His hearty co-operation, coupled with his untiring energy and constant alertness for the upbuilding and success of the enterprise in which he had so keen an interest, was always at the command of the Company, and frequently at great personal sacrifice.

"Always willing and anxious to serve in any capacity for the general good and substantial progress of the community of which in the later years of his life he so completely made himself a part, the State of Maryland has lost a man whom it will be difficult to replace."

The Darlington Grange said:

"* * * Brother Harlow put his trust in God, living a quiet, undemonstrative, but effective Christian life. He nurtured hope, being essentially optimistic, both by nature and conviction. He dispensed charity, was kind to those in need, especially seeking to help men to help themselves. And in all this community, and wherever he was known, he was noted for his fidelity; honorable in all business transactions; faithful to every covenant and agreement."

The Home and Foreign Missionary Society of Harmony Church said:

"* * * We came to appreciate his worth as a Christian man, and the value of his counsel and aid in all our church enterprises. And we are deeply sensible of the loss which the Church as well as the community has sustained by his removal."

The Community Council of Defense, of Dublin Precinct, Fifth District of Harford County, said:

"We cherish the memory of his noble character, his fine Christian spirit, his lofty patriotism, and the wisdom of his counsel."

John A. Walls, M. Am. Soc. C. E., Chief Engineer of the Pennsylvania Water and Power Company, in a letter to Mrs. Harlow, said:

"I feel that in Mr. Harlow's death I have lost a great friend and the world a business man and engineer of high integrity and ability. I cannot tell you how much I have appreciated the friendly counsel given from his mature experience. With pleasure I looked forward to his occasional visits here, for he was always willing to help us somewhat younger men in those of our problems that had been his. His ready acceptance of the new, tempered by a just appreciation of the older established principles in engineering work, made his viewpoints particularly interesting and valuable. I count it a privilege to have known him."

He was married on April 11th, 1872, to Thursa Alice Butler, of Pelham, N. H., who, with their four children, survives him. The oldest child is James H. Harlow, Jr., Assoc. M. Am. Soc. C. E., President of the Havre de Grace Electric Company, at Havre de Grace, Md. The second is Florence Harlow, wife of George F. Rowell, M. Am. Soc. C. E., of Philadelphia; the third is Justin E. Harlow, in charge of the electric current at a sugar refinery at Clinton, Iowa; and the fourth is Miss Alice Harlow, who is about to be graduated from the Nurses Training Course at Johns Hopkins Hospital, Baltimore. He had eleven grandchildren.

Mr. Harlow was elected a Member of the American Society of Civil Engineers on March 4th, 1874.

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## WILLIAM APPLETON HAVEN, M. Am. Soc. C. E.*

DIED JANUARY 6TH, 1919.

William Appleton Haven, the twelfth child of William Haven, merchant, and Sophia (Henderson) Haven, was born in Portsmouth, N. H., on August 12th, 1831. One of his ancestors, Richard Haven, who came to Lynn, Mass., from England on August 23d, 1643, was a carpenter, and worked in several of the new settlements. It is recorded that he built a house in Boston, and refused as part payment therefor a considerable tract of land in that city. As Boston then consisted of three hills, separated by swamps, the prospective value of the land offered did not appear to be as great as that of the house. He went inland about 15 miles, to what is now Framingham, known then, as now, as the "grassy lands", well watered by springs, and there settled and married.

On August 23d, 1843, William Appleton Haven went with his father to Framingham, to attend the second centennial anniversary of the arrival of Richard Haven in America. There were present more than 1 000 of his descendants, comprising the majority of the foremost inhabitants of that part of Middlesex County in which Framingham is situated. No very rich people were among them. They were farmers, tradesmen, ministers, doctors, lawyers, members of various conventions, and early legislators, and it was noted that, for nearly two centuries, there had never been a year in which some descendant of Richard Haven had not been a student at Harvard College.

At about the same time as Richard Haven arrived in Lynn, Thomas Appleton, who traced his ancestry in England back several centuries, came to Ipswich, Mass., and there built a tide-water mill. Many of his

* Memoir prepared by Emile Low, M. Am. Soc. C. E.

sons were graduated from Harvard, and, in 1750, Nathaniel Appleton, D. D., LL. D., was President of that college. His daughter, Mehitable Appleton, was married to the Rev. Samuel Haven, D. D., in 1753. One of the children of this marriage was William Haven, the father of William Appleton Haven.

The elder Haven, at the age of fifteen, was sent to a West India port as a supercargo, continuing to other foreign ports, until the embargo under President Jefferson put a stop to all foreign commerce. He then organized and conducted the first marine insurance company of Portsmouth. When foreign business began again he became supercargo for W. H. and J. Haven, making trips to Calcutta, Marseilles, Buenos Aires, and Savannah. In 1820 he was appointed cashier of the New Hampshire Bank, continuing until the expiration of the charter in 1852.

William Appleton Haven attended private schools until he was fifteen, and then went to Boston, where he was apprenticed for two years with the firm of Brown and Hastings, Civil Engineers and Land Surveyors. On May 10th, 1849, he left Boston, and traveled by railroad to Montpelier, Vt., the temporary terminus of the Central Vermont Railroad, thence by stage to Burlington, by steamboat to Plattsburg, and by stage to Ellensburg, where he took a position as Rodman on the Northern Railroad of New York, then being built from Ogdensburg to Rouses Point (Ogdensburg and Lake Champlain Railroad). The next year he became Leveler, and remained on that railroad until its completion, in the fall of 1850. He then returned to Portsmouth to pursue his studies in civil engineering.

Early in May, 1852, with $50 in his pocket, Mr. Haven started for the West, to get engineering work. His money was soon spent, but his pluck increased, and in June, after many disappointments, he at last found himself in Marquette, Mich., without a cent in his pocket, but with an engagement as Transitman on the survey of the Marquette and Green Bay Railroad, the first railroad projected on the shore of Lake Superior. He was employed on this survey until the work stopped, in August. In the following October, he became Assistant Engineer on the Galena and Chicago Union Railroad, and then Resident Engineer and Roadmaster on the Beloit and Madison Railroad, remaining until 1857. Then he took charge of a locating party on the Milwaukee and La Crosse Railroad. These lines are now parts of the Chicago and North Western Railway.

During 1858 Mr. Haven was Principal Assistant Engineer of the Little Rock and Fort Smith Railroad, in Arkansas, now part of the Missouri Pacific Railway. In 1859 he was a member of the firm of Haven and Ames, Surveyors and Civil Engineers, in private practice in Bloomington, Ill. In the spring of 1860 he was appointed Chief Engineer of the Houston, Trinity and Tyler Railroad, now a part of

the International and Great Northern Railroad, but construction was suspended in December, 1860, "until the troubles in South Carolina blow over." Mr. Haven's headquarters and residence were at Harrisburg, a small village about 6 miles south of Houston, Tex., and he, being a legal voter, as well as a Northern man, in January, 1861, was honored by being taken in a carriage, with an armed escort, to the voting place, where he cast one of the 124 ballots "for secession" (the vote in that town was unanimous). The next day he was requested (a "request" to a Northern man in Texas from the Committee of Safety in 1860-61 would nowadays be called an imperative "order") to join the "Harrisburg Guards", in charge of Capt. "Poker" More. Mr. Haven never knew Capt. More's real name, but his cognomen was given on account of his proficiency in his favorite game.

As a private in this company, Mr. Haven drilled three times a week, and so learned "Scott's tactics." At that date there were neither railroads nor telegraphs connecting Texas with the other States, but steamships arrived at Galveston twice a week with mails, and the news was immediately telegraphed to Houston. On steamer days all the male population of Harrisburg gathered around the railroad station where the telegraph operator intercepted and read aloud the news from the "States." Mr. Haven used to join in the cheers for the South and hisses at the Northern mudsills, "who are afraid to fight."

One morning in April, 1861, the operator read off something that raised louder cheers from the crowd, but made Mr. Haven realize that Texas was no place for him: the news from Fort Sumter; the call for 75 000 men; the movement of the regiments of Massachusetts; the action of the Legislature of New York; and that the whole North was responding to the call of President Lincoln. Following this came orders for the Harrisburg Guards to be ready to start for Galveston the next day, and thence "on to Washington." Luck and pluck enabled him to desert ignominiously from the Guards that evening and catch the steamboat for Galveston. The next day at noon he was on an ocean steamer, outside of Galveston bar, bound for New Orleans. Thence he traveled quickly by river and railroad to Portsmouth.

Mr. Haven remained at home with his mother and sisters during 1861 and until August, 1862, and then, with Joseph H. Thacher and George T. Wilde opened a recruiting station and called for volunteers. They set up a tent on the Parade, hoisted a flag, and got a disabled soldier of the 2d New Hampshire Volunteers to teach "Hardee's Tactics" and drill them and the recruits in the evenings in Jefferson Hall. In October of that year, with about 75 men, they went to the State camp in Concord, and soon became known as Company K, 16th New Hampshire Volunteers, Mr. Haven being Second Lieutenant.

Lieut. Haven was for a time on duty with his regiment at Butte-a-la-Rose, La., but when the fort was abandoned and the barracks

burned, he was delirious with fever and had to be carried to the steamboat. Still burning with fever on arrival at Algiers, Lieut.-Col. Fuller and a lieutenant of Company A, carried him to New Orleans, where he was attended by Dr. Lurton, a skilful resident physician. Lieut. Haven, too sick to join the regiment when it was ordered home, was sent to New York by steamship. He met his regiment at Concord, and was mustered out of service on August 20th, 1863. His fever was followed by dropsy and then by varicose veins.

During the fall and winter of 1863, Mr. Haven bandaged his leg and limped about Portsmouth, but in the early spring of 1864 he obtained employment as Assistant Engineer on a railroad in Connecticut. Then, in the summer, finding that he could work 14 hours a day, and take long tramps, and thinking he could still render some service in the army, he resigned his position and returned to Portsmouth. There he recruited a few young men and went with them to Concord, where he received a commission as First Lieutenant of Company D, 18th New Hampshire Volunteers. His regiment went to Virginia, and he remained on duty until mustered out in June, 1865.

After passing the summer in Portsmouth and Gosport, Mr. Haven again became actively engaged in engineering. During 1866-67 he was Locating Engineer on the Oswego and New York Midland Railroad (now New York, Ontario and Western Railroad); in 1868-69 he was Chief Engineer of the Dixon, Peoria and Hannibal Railroad, in Illinois; and in 1870-71, Chief Engineer of the Chicago and Michigan Lake Shore Railroad, a line from Chicago to Holland, Mich.

In 1871 he was appointed Chief Engineer of the Buffalo, New York and Philadelphia Railroad (now part of the Pennsylvania Railroad), locating and constructing the line between Olean, N. Y., and Emporium, Pa., on the Philadelphia and Erie Railroad, remaining on this work until the end of 1872.

During the winter of 1872-73 he was Assistant Engineer of the New York Central and Hudson River Railroad, stationed at Rochester, N. Y., on double-track work. On April 25th, 1873, he was appointed Chief Engineer of the Wisconsin Central Railroad, stationed at Stevens Point, Wis. The panic of 1873 caused the suspension of all work on this railroad, and in 1874 he returned to Rochester, N. Y., where he owned a home. For several years he was engaged in a manufacturing enterprise, but took up engineering again in 1877, when he was appointed Chief Engineer of the Brattleboro and Whitehall Railroad, a line in Southeastern Vermont, now operated by the Central Vermont Railroad.

In the fall of 1878 Mr. Haven was appointed by the Second Vice-President of the New York, Lake Erie and Western Railroad (now the Erie Railroad) as Engineer in charge of construction of the Buffalo Division. He commenced his duties in Buffalo, N. Y., in Jan-

uary, 1879, having had charge of double-tracking from Burns to Attica, Buffalo terminals, elevators, docks, coal pockets, East Buffalo improvements, and shops. This work was stopped by order of President Jewett in July, 1882. Early in that month, the Buffalo Creek Railroad decided to make extensive improvements, such as double-tracking, rearranging grades, building new iron bridges in place of the old wooden ones, etc., and Mr. Haven was appointed Engineer in charge of construction. Other work was the building of a coal-loading trestle, for shipping coal by lake, which fronted on the City Ship Canal, and an extensive shore protection to prevent the erosion of the Company's land by the waves of Lake Erie. On the completion of the work, on November 1st, 1884, he resigned.

Then, in partnership with S. T. M. B. Kielland, M. Am. Soc. C. E., he opened an office for the private practice of engineering and land surveying. Much of his work consisted of obtaining data in relation to grants, to railroad corporations, of lands and rights in streets and other public property, as well as the boundaries of certain waterways, most of this work having been done formerly by Mr. Peter Emsley, for many years a most reliable and expert surveyor in Buffalo. It was necessary to read the "Proceedings" of the Common Council of Buffalo, and consult the old maps and other records of the City Clerk and the County Clerk of Erie County. Mr. Kielland looked after the maps and Mr. Haven read the 34 volumes of proceedings. In the meanwhile they were engaged in surveying and various engineering employments along the Niagara River and the Buffalo docks. The partnership was dissolved in 1885, Mr. Haven remaining in Buffalo a year longer. In March, 1886, he received an appointment from the late Gen. Adna Anderson, M. Am. Soc. C. E., Chief Engineer of the Northern Pacific Railroad, and removed to Montana. In the summer of 1886 he was in charge of location and construction on the Helena and Red Mountain Railroad, and his jurisdiction was subsequently extended over the Helena, Boulder Valley and Butte Railroad, the Marysville Branch, Elkhorn Branch, Drummond and Phillipsburg Branch, and others of the Northern Pacific lines in Montana, all mountain roads in the mining regions, generally requiring skilful location and the solution of many difficult engineering problems.

Mr. Haven had a painful and trying experience in 1887, when on a visit to Buffalo. He was stopping at the Richmond Hotel, when, on the morning of March 17th, it was completely destroyed by fire. He was awakened by the electric bell in his room, on the third floor, and, hearing cries of "fire", took up his clothes and ran. He fell over a body at the foot of the stairs on the second floor, but picked himself up and rushed for the balcony, from which he was rescued by firemen. He was burned severely, especially about the feet, legs, and head, lay helpless for thirteen weeks, and was then taken to Eastern Massachu-

setts, to the home of his sisters (his father died in 1856, his mother in 1879, and the old home in Portsmouth was gone), thence to Cape Ann, where new cuticle was formed and his health was restored.

As the Northern Pacific Railroad Company, according to its charter, could not build branches until its main line was completed to Tacoma, it organized the Northern Pacific and Montana Railroad Company, of which Mr. Haven, on his return to Montana, was appointed Engineer, on June 21st, 1888. In this capacity he directed the partial location and construction of two important branches, the Butte line of the Northern Pacific Railroad, from Logan to Butte, 70 miles, crossing the main range of the Rocky Mountains and forming a second and alternate line between Logan and Garrison; also the Cœur d'Alêne line, from near Missoula Point to the mining region of the same name in Idaho. The latter was about 120 miles long, and included a very difficult crossing of the Bitter Root Mountains.

In beginning the Montana surveys, Mr. Haven asked Gen. Anderson, "How steep a grade can we use on these branch lines, and how sharp a curve?" The reply almost staggered him, after being used to the maximum 0.5% grade and 4° curves on the Erie Railroad. Nevertheless, a 4% grade and a 22° curve had to be used on the Boulder-Elkhorn line.

Mr. Haven found it difficult to get locating engineers who could make grade-line surveys, and was getting impatient, when he discovered that E. H. McHenry, M. Am. Soc. C. E., one of his assistants, could do the work. This was the beginning of the career of Mr. McHenry, who succeeded Mr. Haven, and was afterward Chief Engineer of the Northern Pacific Railroad.

On May 13th, 1890, Mr. Haven was appointed Superintending Engineer of the West Gallatin Irrigation Company, in charge of the canals of the company in the valley of the West Gallatin River, in Gallatin County, Mont., which comprised about 150 miles.

Following this engagement, Mr. Haven, during 1893-95, was Chief Engineer of a railroad, promoted by Mr. Richard Harlow, planned to run from Helena, through White's Gulch to White Sulphur Springs, and probably farther east. This line was graded from Helena to near Canyon Ferry, but was never completed.

In writing of railroad building in Montana, before and after 1887, John J. Donovan, M. Am. Soc. C. E., says:

"E. H. Beckler, what a world of reminiscence his name arouses? He in charge of the Montana Central Railway, later the Great Northern, I for the Northern Pacific. Both lines under construction through the same canyons to Butte, crossing in the field, fighting in the Courts, yet with no bad blood between the two corps of engineers. Then, when finally Helena welcomed the advent of the Montana Central, we of the Northern Pacific decorated our office with the rest, hung out a big banner across the front: 'N. P. Pay your money. Take your

choice. M. C.', and cheered James J. Hill and Col. Broadwater as they passed. Their hats went up in acknowledgment and they passed on. So we built for our companies and kept faith without loss of friendship."

The Montana Society of Civil Engineers was organized in Helena, on July 5th, 1887, with forty-eight charter members. Col. Joseph T. Dodge was the first President. Mr. Haven was the seventh President, filling first the unexpired term of Col. Walter W. De Lacy, and held the office during 1893 and 1894. From the time that he became President he was active in holding the Society together. During his presidency he adopted the unique system of naming but one member on a committee, claiming that one member would secure better and quicker results than a combination. Mr. James S. Keerl, who was President in 1895, writes of Mr. Haven:

"He was a most genial companion, a gentleman of the old school, and a most entertaining and instructive talker. He was the life of the Society's meetings, and never missed one where it was at all possible for him to attend. He took a lively interest in all classes of engineering, and delighted in discussing any question of engineering presented. The Society owes him a most grateful appreciation for his sterling loyalty and for his earnest work given freely at all times in its behalf, and during the years of its infancy when it needed it most, and those who knew him best enjoyed a deep sense of gratification through his early enrollment among the Honorary Members of the Society."

It may be opportune to state here that Mr. Sigismund Low, the writer's father, was in Helena in 1871, where he had charge of the location of the Northern Pacific Railroad in Montana, under the late W. Milnor Roberts, Past-President, Am. Soc. C. E., Chief Engineer.

During 1886 and part of 1887, the late William H. Kennedy, M. Am. Soc. C. E., was an Assistant Engineer of the Northern Pacific Railroad under Gen. Anderson, engaged on location work through the Prickly Pear Canyon and Boulder Valley.

Mr. Haven was one of the early members in the first organization of Storer Post No. 1, G. A. R., of Portsmouth, N. H., and in 1889 became a comrade of Wadsworth Post No. 3, Department of Montana. He was Quartermaster of Wadsworth Post from 1892 to 1896, inclusive.

In the spring of 1896, Mr. Haven, finding it necessary for climatic reasons to leave Montana, returned to the lower altitude of Buffalo, N. Y. William F. Merrill, M. Am. Soc. C. E., who in 1870 had been one of his Assistant Engineers, was then Vice-President of the Erie Railroad, and appointed Mr. Haven Inspecting Engineer, to look after the interests of that company in connection with the elimination of grade crossings of various streets in Buffalo. In this work other railroads also joined, the whole being done under the direction of the Grade Crossings Commission. He also acted as Engineering Expert in law

cases in which the Erie Railroad Company was involved. He retained his connection with this railroad until his death.

When Mr. Haven returned to Buffalo he became greatly interested in the Engineers' Society of Western New York, and was its President for several years, which included 1901, when the Society held its convention at Niagara Falls.

Owing to the marked attention accorded by him to distinguished visitors from Chile to the Pan American Exposition during that year, he was elected on November 27th, 1901, a Corresponding Member of the Instituto de Ingenieros de Chile, Santiago, Chile.

The following concerning this appointment is taken from the *Buffalo Evening News* of March 8th, 1902:

"President William A. Haven of the Engineers' Society of Western New York and Mr. George A. Ricker of that Society, have been elected members of the 'Institute of Engineers of the Republic of Chile.' Word of this honor to two distinguished Buffalo engineers was received in this city from South America yesterday, and it is understood that this action was taken by the famous Chilean National Engineering Association in recognition of the courtesies shown to visiting engineers of South America by the Engineers' Society of Buffalo during the continuance of the Pan American exposition.

"Mr. Haven, as president of the local association, and Mr. Ricker, as chairman of the Reception Committee, during the Exposition season came in personal contact with several widely known South American engineers and the visitors were much delighted with the arrangements made by the Engineers' Society of Western New York for the entertainment of strangers who were members of the profession.

"They expressed their gratification with a warmth characteristic of their race and it is evident that the memories carried back with them were cordial ones.

"Among the distinguished visitors from Chile was Senor Santiago Sotomayor, who is engaged in a tour of the world in the interests of his government, collecting information for a report on electric railways. Senor Sotomayor is a son of Gen. Sotomayor who was commander-in-chief of the Chilean forces in the recent war with Peru. He was particularly impressed with the electrical progress of Buffalo and Niagara Falls, as well as most appreciative of the courtesies extended to him, and it is believed that the honor bestowed on the Buffalo engineers and the society they represent has come through the suggestion of Senor Sotomayor."

On December 27th, 1870, Mr. Haven was married to Zaidee B. Hartupee, the youngest daughter of Dr. Andrew W. Hartupee, of Chicago, Ill. They had no children.

While in Montana Mr. Haven was a member and one of the Trustees of the First Unitarian Society of Helena.

Many engineers who were assistants of Mr. Haven became prominent later: the late James Edmund Childs, M. Am. Soc. C. E., became President of the New York, Ontario and Western Railroad; the late

Robert Lewis Harris, M. Am. Soc. C. E., became Vice-President of the Erie Railroad and later President of the Northern Pacific and Chicago, Burlington and Quincy Railroads; William Fessenden Merrill, M. Am. Soc. C. E., became Vice-President of the Erie Railroad; Edwin Harrison McHenry, M. Am. Soc. C. E., became Chief Engineer of the Northern Pacific Railroad; the late Charles Latimer, M. Am. Soc. C. E., became Chief Engineer of the Atlantic and Great Western Railroad (New York, Pennsylvania and Ohio), and the late William Edwin Hoyt, M. Am. Soc. C. E., became Chief Engineer of the Buffalo, Rochester and Pittsburgh Railway, and there were many others.

Mr. Haven's natural intelligence, and his long experience and association with prominent engineers, contributed to make him a very interesting personage. He was a veritable "treasure trove" on matters connected with the development of railroad construction and science.

In manners, he was well bred, refined, and still simple. He had a keen sense of humor, and his love for young people was a marked trait; for them he always had kind words and cheer.

His whole life, his actions, his works, and his thoughts were full of the "nobility of his soul." He hated shams and pretense, encouraged all elevating influences, was an honor and pride, and a good example to his race, to his nation, and to his profession. Those who knew him well are the better for having known him.

Mr. Haven was elected a Member of the American Society of Civil Engineers on March 5th, 1873.

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## JAMES NISBET HAZLEHURST, M. Am. Soc. C. E.*

DIED FEBRUARY 9TH, 1919.

James Nisbet Hazlehurst was born at Sparta, Ga., on January 15th, 1864. His father, George Hall Hazlehurst, served as a Colonel of Engineers in the Civil War, and was the owner of the Chattanooga Water-Works, and also Chief Engineer of the Macon and Brunswick Railway.

James Nisbet Hazlehurst received his education in the public schools and at Kirkwood Military Academy, and studied civil engineering for two years at the University of the South, at Sewanee, Tenn.

In 1878, at the age of 14, the boy was employed as a Rodman on the extension of the Memphis and Charleston Railway. In 1879, he was engaged, in the same capacity, on surveys for the Texas and Pacific Railway and on the construction of the New Orleans Pacific Railway. In the spring of 1880, he was promoted to the position of Assistant Resident Engineer of the Shreveport Division of the New

* Memoir prepared by Park A. Dallis, M. Am. Soc. C. E.

Orleans Pacific Railway, and in the summer and fall of that year and the winter of 1881, he served as Assistant Engineer and Division Superintendent on the construction of that road from Bayou La Fourche to Provençal, La.

Later, in 1881, Mr. Hazlehurst was employed as Assistant Engineer and Superintendent for A. J. Lane and Company, Contractors, on the construction of 120 miles of the Pensacola and Atlantic Railway. In 1882 he went to the New Orleans and Mississippi Valley Railway as Superintendent in charge of the extension from Vicksburg to Port Gibson, Miss., and from Baton Rouge, La., to the Mississippi State Line. He spent the fall and winter of 1884-85 as a student at the "School of Design", in Cincinnati, Ohio, and, from 1885 to 1887, was General Manager of the Lookout Iron Works and Director of the Lookout Water Company, Chattanooga, Tenn., as well as of the Montgomery Water-Works, Montgomery, Ala.

In 1887 Mr. Hazlehurst was Principal Assistant Engineer on location for the Macon and Dublin Railway, but, in 1888, he engaged in private practice as senior member of the engineering firm of Hazlehurst and Hendricks, at Macon, Ga. In 1890 he returned to railway engineering as Chief Engineer on location and construction, and, later, as General Superintendent and Engineer, of the St. Augustine and North Beach Railroad. During 1892 and 1893 he acted as Receiver for the Macon, Ga., Brewing Company, and, during 1893 and 1894, as General Superintendent and Treasurer of the Acme Brewing Company. At this time the Board of Public Works, of Macon, Ga., of which Mr. Hazlehurst was a Charter Member, was organized.

In the fall of 1894, he was employed as Constructing Engineer by Gaboury and Noble, Contractors, on sewers for Macon, Ga., and retained that position until the spring of 1895, when he again engaged in the private practice of engineering as the senior member of the firm of Hazlehurst and Company, General Contractors and Engineers, with offices at Atlanta, Ga. This firm contracted for all the sewer work done in Atlanta in 1895, and constructed the sewers and water mains for the Atlanta International and Cotton Exposition. Mr. Hazlehurst also acted during 1896 and 1897 as Consulting Engineer on the design and construction of water systems for Clarksville, Tenn., New Orleans and Algiers, La., Morristown, Tenn., St. Augustine, Fla., Forsyth, Ga., Grenada, Miss., Dyersburg, Tenn., and Hazlehurst, Miss. He also acted as Consulting Engineer to Parrott, Paterson and Company.

In the winter of 1897, Mr. Hazlehurst was appointed Acting City Engineer of St. Augustine, Fla., and completed the water-works of that city and paved most of its streets. In 1898 he was appointed Chief Engineer of the Board of Public Works of Tampa, Fla. In this capacity he located and constructed a complete system of sewers,

grading, pavements, and other public improvements. He also served as City Engineer of Tampa.

In 1900 he went to New Orleans, La., as Chief Engineer of the Miles Salt Company, but, in 1901, he removed to Mobile, Ala., where he was appointed Chief Engineer of the Board of Public Works, which position he retained for five years. In 1906 he returned to Atlanta, Ga., opened an office as a Consulting Engineer, and became prominently identified with the engineering activities of that city. He was widely known throughout the South, through his connection as Consulting Engineer for many cities, among which were La Grange, Ga., Raleigh, and Wilmington, N. C., Miami, Key West, Lakeland, and Dunnellon, Fla., and Mobile, Ala. He also made appraisals of water-works for Macon, Ga., Raleigh, N. C., Chattanooga, Tenn., Ocala, Fla., etc.

When the United States entered the war, Mr. Hazlehurst immediately offered his services to the Government. He was commissioned a Major of Engineers on June 20th, 1917, and assigned to the staff of Maj.-Gen. Leonard Wood, Commander of the Department of the Southeast, as Officer in charge of the Water Supply Section for the camps in the Southeastern States. In September, 1917, Maj. Hazlehurst, with other engineers, was ordered overseas in response to Gen. Pershing's request for expert engineers, and was made Principal Assistant to the officer in charge of the Water Supply Section of the American Expeditionary Forces at Chaumont, France. Later, he was attached to the Third British Army, as an observer in the Valley of the Somme, and was afterward transferred to Tours as Principal Assistant to the officer in charge of the Water Supply Section of the American forces at that place.

In October, 1918, Maj. Hazlehurst was ordered to the South of France, as Engineer Officer in charge of construction and as Water Supply Officer for Army Base No. 6, his territory extending from the Riviera to the Italian frontier. Later, he was transferred to Paris as a member of the American Peace Commission, and was assigned to the Economical and Financial Section of the Belgian Commission, the duty of which was to study and check the damage due to the German occupation. Maj. Hazlehurst's particular studies were mines, metallurgy, railways, and industrial and general buildings, and he was made Director of the Division having to do with damages to buildings in Brussels, Belgium. While on this duty he was taken ill and died in that city on February 9th, 1919.

Maj. Hazlehurst was one of the foremost engineers of the South, and was prominently identified with the engineering activities of Chattanooga, Tenn., and Atlanta, Ga. As a resident of the latter city, he took a leading part in the organization of the Affiliated Technical Societies of that place, the first organization of its kind in the United States. He also served as Chairman of the Committee on Engineering and Good Roads of the Atlanta Chamber of Commerce, was a member

of the Commission which selected the site of Camp Gordon as a military cantonment, and a member of the National Council of Defense. Maj. Hazlehurst was also a member of the American Waterworks Association and the American Public Health Association. He had written a number of articles for various technical publications and was the author of a book entitled, "Towers and Tanks."

He was married in 1886 to Miss Mary Griffiss, of Chattanooga, Tenn., who, with two sons, George Hall Hazlehurst, Sanitary Engineer of the State of Alabama, Montgomery, Ala., and Capt. John G. Hazlehurst, U. S. A., survives him.

Mr. Hazlehurst was elected a Member of the American Society of Civil Engineers on October 4th, 1899. He was a Charter Member and the first Chairman of the Executive Committee of the Atlanta Association of Members of the American Society of Civil Engineers.

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## FRANK CHURCHILL HORN, M. Am. Soc. C. E.*

DIED FEBRUARY 16TH, 1919.

Frank Churchill Horn, the son of Adam E. and Martha P. Horn, was born at Macomb, Ill., on January 8th, 1861. He was educated in the public schools and under private instructors.

His first engineering engagement, after acquiring some experience as assistant to an engineer in private practice, was in 1882 as Assistant Engineer on the construction of the St. Louis and San Francisco Railroad in Western Arkansas. In 1884, he was engaged as Assistant Engineer on railway location, in Iowa, Minnesota, and Dakota, for the Burlington, Cedar Rapids, and Northern Railway.

From 1885 to 1889, Mr. Horn was Principal Assistant Engineer, and, later, Chief Engineer and Superintendent, of the Department of Public Works of Lake, Ill. During this period he remodeled and enlarged the sewerage and water-works systems, besides making many other improvements in the town.

From 1889 to 1894, he served as Engineer and Superintendent for a number of contracting firms in the construction of water-works and sewerage systems in Indiana, Alabama, Ohio, and Illinois, and also for the construction of the Intramural Railway for the World's Columbian Exposition at Chicago.

In the autumn of 1894 he was engaged by the Lake Shore and Michigan Southern Railway on track elevation in Chicago. In 1895 he was employed by the Sanitary District of Chicago to construct the regulating works of the Chicago Drainage Canal at Lockport, Ill., and, again, in 1898-99, he was placed in charge of building masonry structures and bridges on the Drainage Canal. In 1900 he was

* Memoir prepared by A. J. Wiley, M. Am. Soc. C. E.

employed by the Economy Light and Power Company on the construction of the hydro-electric plant at Joliet, Ill.

In September, 1900, Mr. Horn came to Idaho as Assistant Chief Engineer on the construction of the Swan Falls Hydro-Electric Plant on Snake River. On the completion of this work in 1901, he became Assistant Chief Engineer of the Denver Union Water Company, of Denver, Colo., and was placed in charge of the construction of the Platte River Canyon filtration plant and afterward of the Lake Cheesman Dam which forms a reservoir for the storage of the Platte River water for the City of Denver.

In 1905 Mr. Horn was appointed Construction Engineer in the United States Reclamation Service, and came to Idaho as Construction Engineer, first for the Minidoka rock-fill dam on Snake River, then for the Boise River concrete diversion dam and the Upper and Lower Deer Flat earth-fill embankments.

Resigning from the Reclamation Service in 1908, he became Construction Engineer for the Salmon River Dam of the Twin Falls Salmon River Land and Water Company, near Twin Falls, Idaho. On the completion of this work in 1911, Mr. Horn opened an office in Boise, Idaho, as Consulting Engineer, and continued in this practice for the remainder of his life. In connection with the lining of the tunnels at the Salmon River Dam, he invented a process for the pneumatic conveyance and placing of concrete and devoted much of his energy to developing this process and putting it in commercial use. Among the most successful examples of its application were the lining of the Port Richmond and Stockton Street Tunnels in San Francisco.

Mr. Horn's most prominent characteristic as an engineer was the uncompromising thoroughness of his work. This was shown very strongly on the Lake Cheesman Dam, which is one of the very few, if not the only, rubble masonry dam which, from its first construction, was entirely free from any trace of seepage or sweating.

From his early experience in contracting, he acquired a taste for the personal conduct of construction work, and was always a strong advocate of force-account construction as opposed to contracting for the work under his charge. The Upper Deer Flat Embankment of the Deer Flat Reservoir of the United States Reclamation Service in Idaho is an earth dam containing more than 1 000 000 cu. yd. This dam was built by Mr. Horn with Government forces and equipment at a saving of more than $100 000 below the lowest bid. The Salmon River Dam, containing about 150 000 cu. yd. of concrete and 3 600 ft. of outlet tunnel, was also done under his direction by force account at a very low cost. He was an expert in all classes of construction machinery, and was employed by the United States Reclamation Service as Consulting Engineer in the selection of the construction equipment for the Arrowrock Dam in Idaho.

Mr. Horn was intensely loyal to his associates, and had their unqualified confidence, affection, and respect. He was an unselfish and devoted friend, and few men stood higher in the community where he spent the last years of his life. Though not a college graduate, he was elected a member of the University Club of Boise, and was its Vice-President at the time of his death. He was very much interested in questions of public health and, at one time, paid the hospital fees for the public school children of Boise, whose circumstances would otherwise have prevented them from having a necessary operation.

He was married on June 24th, 1888, to Margaret K. Ferguson, of Guelph, Ont., Canada, who died in 1899, leaving no children. His intense devotion to the memory of his wife was one of the most touching of his many noble and lovable traits.

He died in Boise, as the result of a stroke of apoplexy, on February 16th, 1919. He is survived by a sister and two brothers, and leaves many friends and associates among whom his memory will always be cherished.

Mr. Horn was elected a Member of the American Society of Civil Engineers on September 1st, 1903.

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## LEWIS ABEL NICHOLS, M. Am. Soc. C. E.*

DIED MARCH 5TH, 1919.

Lewis Abel Nichols was born in Florence, Italy, on August 26th, 1851, of American and English parents. After his mother's death in 1856, his father returned to the United States with his family, and settled in Danvers, Mass. He died in 1858, and Mr. Nichols was left an orphan at the age of seven.

After attending the public schools and High School at Danvers, he entered the Massachusetts Agricultural College at Amherst, Mass., in 1867, and was graduated in 1871, in the pioneer class of that institution.

Having chosen Civil Engineering as a profession, Mr. Nichols began his life work in the fall of 1871, by laying out town lots in an addition to the City of Fall River, Mass. During the latter part of the same year, he was employed as a Leveler on the location of the Massachusetts Central Railroad. In 1872 he was placed in charge of the party and finished the location and construction of a Division of the railroad in the fall of 1873.

In 1874 and 1875, Mr. Nichols was engaged in private practice in Eastern Massachusetts. He was elected City Engineer of Chelsea, Mass., in 1875 and retained this office until 1877, when he resigned to take charge of the Marblehead Water-Works. In 1878 he resumed his private practice, maintaining an office in Boston for two years.

* Memoir prepared by the Secretary from information on file at the Headquarters of the Society.

During 1880 and 1881, Mr. Nichols was a Transitman on reconnaissance, preliminary, and location surveys in New Mexico and Arizona, for the Atchison, Topeka and Santa Fé Railroad. In the latter year, he was appointed Division Engineer on the California Southern Railroad, and was in charge of some particularly heavy and difficult work in the Temecula Canyon, California. During 1883 and 1884, he was employed as Division Engineer on the Tampico Division of the Mexican Central Railroad, in charge of the location and construction of more than 100 miles of heavy mountain road.

Mr. Nichols was Engineer of Buildings on the Chicago, Burlington, and Northern Railroad in 1886, and, in the spring of 1887, became Locating Engineer for that road on projected branches. He was Assistant Chief Engineer on the Illinois Valley and Northern Railroad in 1887 and 1888, and, in the latter year, Locating Engineer on the Oregon Railway and Navigation Company's extension through Idaho. In 1889 he was Office Engineer on the Toledo, St. Louis and Kansas City Railroad, and, in 1890, built some exceptionally heavy and difficult work on the Cumberland Valley Extension. During 1891 he served as Locating Engineer on the Toledo and Chicago Bee Line, but it was not built. Mr. Nichols then became Chief Engineer of the La Salle and Bureau County Railroad, a belt line to connect the Illinois Central, Chicago, Burlington, and Quincy, and the Chicago and Northwestern Railroads in the vicinity of La Salle, Ill.

The foregoing gives some indication of the extensive and responsible railroad work done by Mr. Nichols. In 1908, he gave up the active practice of his profession, except as a Consulting Engineer, and devoted most of his time to the interests of the Chicago Steel Tape Company, a corporation which he organized in 1903, and of which he was President at the time of his death.

Mr. Nichols was married in 1879, to Miss Carrie W. Putnam of Danvers, Mass. They had no children.

He was a member of the Woodlawn Park Lodge, A. F. and A. M., of Chicago. He was also a member of the Western Society of Engineers and several other technical societies.

Mr. Nichols was elected a Member of the American Society of Civil Engineers on October 5th, 1892.

## HOMER PETER RITTER, M. Am. Soc. C. E.*

DIED APRIL 21ST, 1919.

Homer Peter Ritter was born in Cleveland, Ohio, on March 4th, 1855, and received his early education in the schools of his native city. On being graduated from the Cleveland High School, guided by an artistic temperament which was a marked characteristic through life,

* Memoir prepared by R. L. Faris, M. Am. Soc. C. E.

he entered the Cincinnati School of Design, but, after a short stay, withdrew from this institution and matriculated in the School of Mines, Columbia University, New York City. At Columbia he selected a special course in Civil Engineering, and, on its conclusion, in 1880, received an appointment in the service of the Mississippi River Commission and was at once assigned to the field. As the Commission was organized in 1879, Mr. Ritter was one of its first employees, and, in the five years between 1880 and 1885, was engaged as Assistant United States Engineer in the topographic and physical hydrographic operations on which were based the comprehensive plans for the regulation of the great river.

In 1885, Mr. Ritter was transferred to the U. S. Coast and Geodetic Survey, for employment in the physical hydrographic surveys and examinations, under Professor Henry Mitchell, that were a necessary antecedent for the improvements that have met the demand for the modernization of the waterways about New York City; and, later, on similar surveys in the waters adjacent to Boston and off the New England Coast; and on general hydrographic and topographic work of the Survey. In 1893 he was appointed American representative in a Canadian photo-topographic party which formed a unit in a group of American and Canadian parties which initiated the exploratory surveys and maps that were used by the Alaskan Boundary Tribunal in laying down the line of delimitation between the United States and British possessions between Mt. St. Elias and the Portland Canal.

In 1895, Capt. Ritter was appointed Assistant in the normal force of the Coast and Geodetic Survey, a designation of rank which was changed to that of Hydrographic and Geodetic Engineer in 1917. From 1898 to 1904 his work was confined entirely to the Pacific Coast, and included a large portion of the range of duties covered by the Survey. In 1898 his services included magnetic and astronomical operations in California and Nevada; from 1899 to 1903, in command of the U. S. Coast and Geodetic Survey steamer *Taku,* he was employed on triangulation, hydrography, and topography in Controller Bay, Prince William Sound, and about Kodiak Island; and in 1904 he commanded the U. S. Coast and Geodetic Survey steamer *McArthur* engaged in special surveys about Kiska, one of the extreme western islands of the Aleutian Group.

In 1904, Capt. Ritter, on nomination by President Roosevelt, was confirmed by the Senate, as a member of the Mississippi River Commission, thereby renewing his connection with the body which he had entered at the beginning of his professional career, and in which he was destined to render his last service, for it was from a regular trip of inspection of the Commission that he returned incapacitated by the illness which caused his death within four days after his return to his home in Washington, D. C.

In 1904, Capt. Ritter was transferred from duty on the Pacific Coast to the Coast and Geodetic Survey Office in Washington, D. C., and the remainder of his services were rendered on the Atlantic Coast, and, in the interval between the beginning of 1905 and his death on April 21st, 1919, these were of a greatly varied and highly valuable character. Besides his active employment for 15 years as a member of the Mississippi River Commission, he was engaged as a member on the 14-ft. Waterway Board; completed a thorough physical hydrographic survey of the Potomac River, in connection with the determination of the causes and correction of its pollution; repeatedly was assigned to determine and locate speed courses for the Navy; make extensive resurveys for chart revision in Chesapeake Bay, Long Island Sound, and along the coast of Massachusetts; and conducted an extensive triangulation in North Carolina. His last assignment to duty in the Coast and Geodetic Survey was to the position of Inspector in Charge of the U. S. Coast and Geodetic Survey Field Station at Boston, Mass., and during this incumbency, which continued to the day of his death, he was conducting revision surveys along the Massachusetts Coast.

Capt. Ritter was a man of unostentatious but admirable qualities, and especially distinguished by a rare type of humor which was blended with a singular knowledge of humanity and a depth of sympathy that seemed unfathomable. It is related of him that when but little more than a youth, during one of the great floods in the Lower Mississippi, in the face of a danger that forbade others to adventure it, he went, alone, in a dugout, to the rescue of an unfortunate negro who, marooned on the roof of a cabin, was being hurried to destruction by the raging river, and brought the man to safety. At another time he and one companion, during an outbreak of fever, resisting the fear that drove off their other well companions in panic, abided with those stricken down by the disease until all danger from contagion had passed and medical assistance could be brought to them.

Capt. Ritter was married on April 12th, 1912, to Miss Katherine R. Wagner, of Piqua, Ohio, and, besides his widow, is survived by two brothers and two sisters. He had been a member of the Cosmos Club of Washington since 1892.

Capt. Ritter was elected a Member of the American Society of Civil Engineers on November 3d, 1915.

## RUFUS MASON WHITTET, M. Am. Soc. C. E.*

Died December 10th, 1918.

Rufus Mason Whittet, son of Alexander and Isabella (Proudfoot) Whittet, was born on October 17th, 1878, in Lowell, Mass. He came

* Memoir prepared by X. H. Goodnough, M. Am. Soc. C. E.

of Scotch ancestry, being a lineal descendant of James Whittet, of Kintillo, Scotland.

He was educated in the Lowell public schools, having been graduated from the Moody Grammar School in 1893 and from the Lowell High School in 1897, at the age of nineteen. Deeming it wise to continue his academic studies further, he returned the following year to the Lowell High School, taking the Post Graduate Course.

Mr. Whittet then passed the entrance examinations for both Harvard College and the Massachusetts Institute of Technology. Deciding in favor of Technology, he entered that institution in 1898 and was graduated in June, 1902, with the degree of Bachelor of Science in the Department of Sanitary Engineering, presenting as his thesis: "A Study of the Stream Flow Records of the United States Geological Survey."

After being graduated from the Massachusetts Institute of Technology, Mr. Whittet joined the Engineering Staff of the State Board of Health, and in the wide field of work covered by that Department he found employment congenial to his tastes. Taking a deep interest in its work, he soon became a most valued member of its staff, and was the Principal Assistant Engineer of the Department at the time of his death.

He was a civil engineer who believed in the elevation and dignity of his profession, and he acted on this belief with a fine enthusiasm. His principal characteristics, clear thinking and sound judgment, were combined with great executive ability, and his early death ended a career begun with great promise.

Mr. Whittet was a member of the Boston Society of Civil Engineers, the New England Water Works Association, and prominent in the Masonic Fraternity.

He was married in September, 1916, to Effie Osgood Byron, of Jamaica Plain, Mass., who, with a daughter, Helen Isabella, born on January 16th, 1918, survives him.

In appreciation of his service to the State, the State Department of Health adopted the following tribute to his memory:

"Rufus Mason Whittet, C. E., Principal Assistant Engineer of this Department, died on December 10th, 1918, a victim of the prevailing influenza epidemic.

Mr. Whittet joined the Engineering Staff of the State Board of Health upon his graduation from the Massachusetts Institute of Technology in 1902, and has been the Principal Assistant Engineer of the Department since 1908.

His energy, thoroughness, clear thinking and sound judgment were of invaluable assistance in the studies of water supply and drainage and the great variety of kindred problems embraced in the work of the Department, while his quiet manner, his fairness, and his kindness made work with him a pleasure. These qualities, with a high sense of

honor and loyalty to his associates, made him respected by all and loved by a wide circle of friends."

Mr. Whittet was elected an Associate Member of the American Society of Civil Engineers on May 2d, 1911, and a Member on November 4th, 1914.

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## CHARLES EDWIN BRIGHT, Assoc. M. Am. Soc. C. E.*

DIED APRIL 3D, 1919.

Charles Edwin Bright was born in Sumner County, Tennessee, on December 27th, 1866. He was the son of Dr. Charles T. and Mary Branham Bright.

After attendance at the public schools of Sumner County, Mr. Bright entered Vanderbilt University at Nashville, Tenn., to take up civil engineering, but, in 1887, he had to give up college, after having completed three years of the four-year course.

From June, 1887, to February, 1888, Mr. Bright was engaged as Rodman in the City Engineer Department of Nashville, Tenn., and from February to November, 1888, as Transitman, Leveler, and Resident Engineer on the location and construction of dummy railways and general city surveying.

From January to May, 1889, he was employed on the Florence Northern Railway as Transitman, Leveler, and Assistant Engineer on location and construction in Alabama and Tennessee, and after making a survey for a highway bridge across Duck River, at Columbia, Tenn., in May, 1889, he served as Leveler (June, 1889) on the Louisville and Nashville Railway on the location of 10 miles of double track. In July and August of that year, Mr. Bright was again employed with the City Engineer Department of Nashville as Inspector of granite block pavement for the city. In September, 1889, he entered the employ of the East Tennessee Land Company and had charge of a party making a topographical survey for, and staking out, the Town of Harriman, Tenn., as well as the preliminary surveys and location for the Harriman and Brushy Mountain Railway, on which he also served as Resident Engineer on construction.

From December, 1891, to October, 1895, Mr. Bright was with the United States Engineer Department, Nashville District, on the improvement of the Cumberland River, making location surveys for Locks Nos. 2, 3, and 4. He also acted as Inspector in local charge of the construction of Lock No. 3.

From February to July, 1896, he was engaged as Superintendent for the contractors on the construction of a masonry wall enclosing

* Memoir prepared by B. M. Taylor, Asst. Valuation Engr., Louisville and Nashville Railroad, Louisville, Ky.

the Tennessee State Penitentiary and also superintended the construction of a 4-mile extension of the Nashville, Chattanooga, and St. Louis Railway, for the Duck River Phosphate Company.

In July, 1896, he again entered the service of the U. S. Engineer Department, serving until December of that year as Overseer of the Nashville District; from January, 1897, to June, 1898, as Draftsman and Photographer in the office at Nashville; and from June, 1898, to March, 1900, in local charge of the construction of Lock No. 6 on the Cumberland River. In May, 1900, Mr. Bright was transferred to the Mobile District and put in local charge of the construction of Lock No. 5 on the Warrior River, Alabama, remaining on this work until August, 1901.

At this time, he concluded to exploit his engineering talent in another field, and, for a number of years, was engaged in railroad location and construction on the Tennessee Central Railroad, the Louisville and Nashville Railroad, the Tidewater Railway, and the Nashville, Chattanooga, and St. Louis Railway. On the Tennessee Central Railroad, he was employed as Resident Engineer on construction and Assistant Engineer on maintenance of way. On the Louisville and Nashville Railroad, he was Resident Engineer at Dossett, Tenn., for 2 years, constructing several miles of road, including the Dossett Tunnel. He was then employed for about 14 months on the Tidewater Railway, part of the time on location surveys and part as Resident Engineer on construction. His last railroad work was on various surveys for the Nashville, Chattanooga, and St. Louis Railway, covering about 2 years prior to April, 1908.

The service of the Government again attracted Mr. Bright, and, in April, 1908, he took charge in the field of the completion of Colbert Shoals Canal and Lock on the Tennessee River at Riverton, Ala., remaining there about 5 years. On this project he had charge of extensive concrete river wall construction, the grading of the canal trunk, the erection of the massive lock-gates and their maneuvering gear, and the construction of steamboats, barges, and dredges after the canal was opened to traffic.

Malaria contracted at Riverton so affected his health, that he had to give up river work. He then removed to Nashville, Tenn., where, from August, 1913, to August, 1914, under the direction of the City Engineer, he rebuilt that portion of the City Water Reservoir, which shortly before had failed destroying considerable property in its vicinity.

In August, 1914, Mr. Bright became a member of the Engineering Staff of the Division of Valuation, Interstate Commerce Commission, serving as Assistant Field Engineer until June, 1917, and as Field Engineer from that date until his death, which occurred at his home in Nashville, Tenn., on April 3d, 1919.

Mr. Bright was married on May 8th, 1898, to Miss Laura Doxey, of Hendersonville, Tenn.

Throughout his career, he was always loyal to his profession, conscientious and competent in the performance of his duties, and, in his death, the Engineering Profession lost one of its best men.

Mr. Bright was elected an Associate Member of the American Society of Civil Engineers on December 3d, 1902. He had also been a member of the Engineering Association of the South since 1890.

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## ANGUS ROBERT MACKAY, Assoc. M. Am. Soc. C. E.*

DIED JUNE 29TH, 1918.

Angus Robert Mackay, the eldest son of the late Senator Robert Mackay, was born at Montreal, Que., Canada, on October 27th, 1872. After his preparatory education, he entered the Massachusetts Institute of Technology, from which he was graduated in Mining Engineering in 1894. During 1894 and 1895, he studied at the Berg Academie and the University of Berlin, Germany.

On his return to the United States in 1895, Mr. Mackay was employed by the Horseshoe Mining and Milling Company, of Deadwood, S. Dak., as Manager of its mining interests and of its reduction plant, the Kildonan Mill, at Pluma, S. Dak. He retained this position until the property was sold in 1901.

From 1902 to 1904 he was engaged in research work and study for mining interests at Sault Ste. Marie, Ontario and Michigan, and also at Sydney, Nova Scotia.

In 1904 Mr. Mackay joined the Engineering Staff of the Electrical Development Company of Ontario, at Niagara Falls, Ont., Canada, on one of its large hydro-electrical projects. He also had charge during this time of some hydraulic surveys and investigations near Lake Superior for Hugh L. Cooper, M. Am. Soc. C. E.

From 1906 to 1907 he was identified with, and had an interest in, a foundry enterprise near Montreal, Que., Canada; and, from 1907 to 1908 was engaged as Advertising Manager for the Canadian Fairbanks Company, with headquarters at Montreal.

In 1908 Mr. Mackay entered the employ of the General Exploration Company, of Boston, Mass., and was sent by that Company to Wickenburg, Ariz., as Manager of the Vulture Mine. He supervised the construction of a 20-stamp mill and a cyanide plant, and developed the property into a successful business. He retained this position until his death, which occurred suddenly at Oakland, Cal., on June 29th, 1918.

* Memoir prepared by the Secretary from information on file at the Headquarters of the Society.

Mr. Mackay's activities were numerous and varied; he was particularly interested in the development of the natural resources of Arizona. To his friends and business associates, who were many, his death came as a shock, and he will be greatly missed by all who knew him and worked with him. He had been a member of the American Institute of Mining Engineers since 1896.

Mr. Mackay was elected an Associate Member of the American Society of Civil Engineers on October 29th, 1912.

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## AUSTIN RUSSELL WILLARD SPERRY, Assoc. M. Am. Soc. C. E.*

DIED DECEMBER 6TH, 1918.

Austin Russell Willard Sperry, the only son of Austin B. and Katherine M. Sperry, of the family that organized the Sperry Flour Company, was born in Stockton, Cal., on December 26th, 1888.

He attended the Stockton schools, spent two years in the High School, and then went to Berkeley and studied at Boone's University School for two years. He was graduated in Civil Engineering from the University of California in 1910, having been a member of the G. E. K. High School Fraternity and the Alpha Delta Phi College Fraternity. He was a member of the 'Varsity crew and was also an accomplished 'cellist.

Immediately after his graduation, Mr. Sperry started work as an Inspector in the Maricopa oil fields, but soon moved to the Crocker-Huffman Irrigation Project, near Merced, and before the completion of this work he had risen to be Chief Engineer. He continued this specialty of irrigation engineering until his death. In 1912, he took hold of an irrigation unit for the Natomas Company of California and completed an extensive system. He then directed the operation and maintenance of the system, and also took charge of the works of the Folsom Water Company, looking after the water supply and retaining dams in connection with the fleet of gold dredges operated by this Company.

In March, 1917, he accepted the position of Supervising Engineer for the Anderson Cottonwood Irrigation District, in the Upper Sacramento Valley, and directed work involving an expenditure of $700 000. The many extensive and, in several cases, unique structures in this District, as well as the excellent character of the work, stand as monuments to Mr. Sperry's engineering ability and initiative.

In addition to his engineering activities, Mr. Sperry was associated in a financial way with the Rising River Ranch Company, which owns extensive stock ranges.

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* Memoir prepared by R. G. Clifford, Assoc. M. Am. Soc. C. E.

On September 25th, 1912, he was married to Gertrude Fancher, of Merced, Cal., who died on January 19th, 1917, leaving one daughter, Katherine. On July 12th, 1918, he was married to Marguerite Cron, of Berkeley, Cal., who, with his mother, survives him.

His integrity of character, lovable personality, and ability in handling men had endeared him to all with whom he came in contact, and the blow to his loved ones and friends was the more severe in that he was stricken suddenly, in the prime of life, with a brilliant future opening up in his chosen profession. He leaves a host of warm personal friends and business associates.

Mr. Sperry was elected a Junior of the American Society of Civil Engineers on December 6th, 1910, and an Associate Member on January 15th, 1917.

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